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JANUARY 19, 1928

Engineering News-Record

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...ting Section of Oakland Estuary Tube into Place

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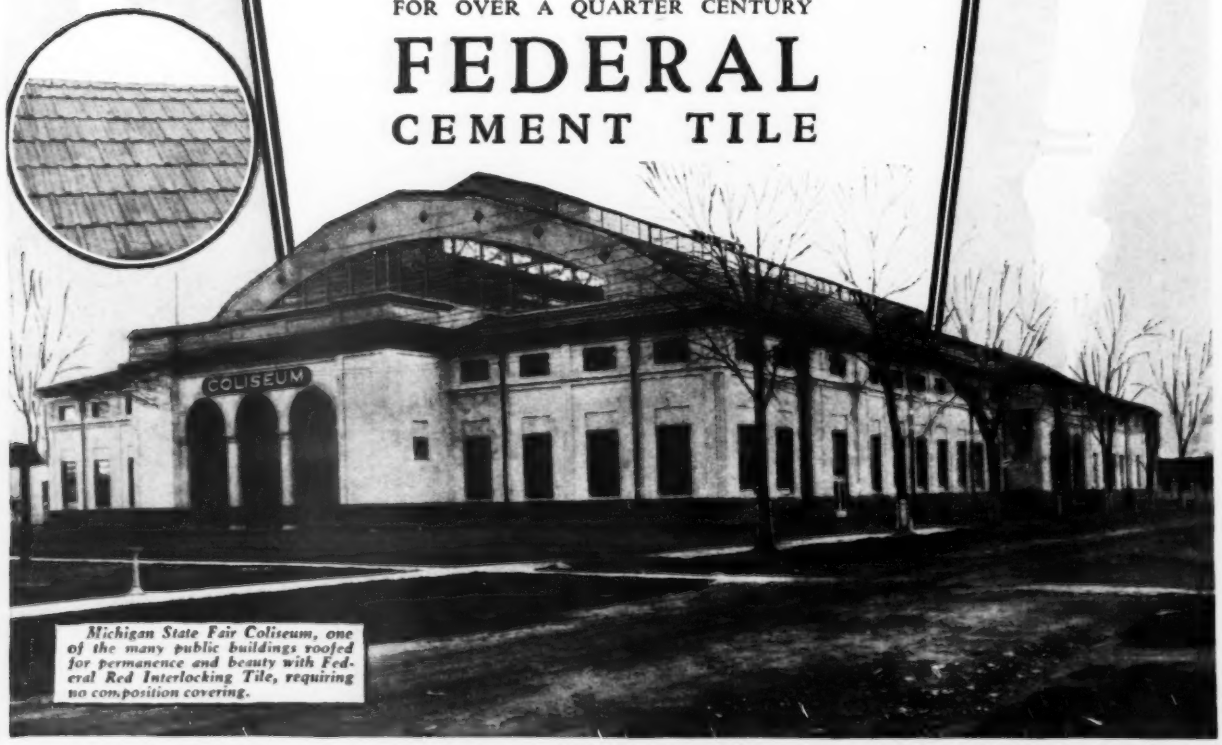

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

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A Real Investigation

SINCE our comments on the tragic fate of the submarine S-4, ground for hope has appeared that the Navy custom of investigating itself will not wholly be adhered to on this occasion. The accident itself is now under inquiry by a Navy board. But the subject of future safeguarding of submarines may be put into the hands of a board whose majority will consist of men from civil life. Such a recommendation has been made by the Secretary of the Navy, and Congress is expected to act favorably on it. It is the first ray of light in an utterly gloomy affair. It gives promise of a real investigation, a study of submarine construction and operation based not on naval traditions but on the broadest considerations of efficiency, sound practice and humanity.

Honoring Co-operative Effort

YOUNGEST of the great fields of human productive effort, the electrical field gives frequent evidence of its youthful strength and originality. It has had the original thought to bestow honor on those who attain high achievement in co-operative effort, by an award for co-operation—the McGraw Award. Last week its leaders assembled at the call of the Society of Electrical Development to join in the bestowal of this award on W. W. Freeman, of Cincinnati, for conspicuous success in bringing together in joint endeavor men and interests that otherwise would have remained apart and for that reason would have been less effective in their labors. We do not recall any other industrial or professional group that has had the inspiration thus to honor one of the highest forms of human striving. Medals, degrees and other honors for individual accomplishment are not unknown, but honors for co-operation are new under the heavens. There is high virtue in such an honor. If it be fitting to distinguish one who has achieved something by his own power, surely it is no less worthy to accord distinction to those who weld separate endeavor into co-operation. And this is just as true for every type of human activity as for the electric power industry. Professional engineering and the construction industry have quite as much need for co-operation as has the electrical group, and might as fittingly give special honor to those who achieve in co-operation. We can learn from our electrical colleagues; and in the meantime we may be sure that they are accelerating their own progress through the noble rivalry in further co-operation which their award stimulates.

The Unexpected Again

ONCE more the unexpected in floods is recorded, this time in England, where the Thames rose to a stage beyond precedent, even to the extent of flooding river-bank districts in London and causing a number of basement drownings. Apparently the causes of this great flood lay in a combination of the melting of exceptional snowfall, a spring tide and a wind that drove the water up the mouth of the river. The result was a stage which, if not quite unprecedented, appears to have surpassed all the stages known for many decades past. Such high water evidently had not been taken into account in the planning of the river wall or the adjacent buildings, otherwise the score or so of fatalities would not have occurred. Thus it is seen that even in an old country, possessed of centuries of experience with its streams, catastrophal flood stages may come about, exceeding the provision of protective works and other safeguards. Only a few months ago we had occasion to note this same fact when several disastrous floods occurred on the European Continent. We in the United States have generally attributed our frequent and great flood losses to lack of knowledge of flood possibilities, because of our short history and records. But we may now learn that even long historical experience does not give adequate knowledge in itself. Even in the older countries such experience requires to be supplemented by study of possible stream-flow combinations and analysis of stages before data are obtained that will serve as the basis of devising adequate protection. Such a teaching spoke out of the facts of the New England floods of last November; it is reinforced by the occurrence of the English flood, which adds convincing force to the present movement for systematic flood study.

For Flood Study

REPEATEDLY in these columns we have urged the vital necessity of a nation-wide study of rainfall and flood possibilities. Flood disasters in a steady sequence have demonstrated how little is known about flood risk and how impossible it is to stir communities into protective action before the risk has come to actual realization. Adequate study of floods is so great an undertaking, however, that only the federal government seems capable of carrying it out. Up to the present the inertia of the government has stood in the way of its taking up the task, but now there is a prospect of action, under the terms of a bill before Congress—the Newton bill. A similar bill was before the last Congress, but, like many others, failed to come to vote. Curiously enough, the Newton bill on its face is not concerned with floods at all, but is a measure of comprehensive scope providing broadly for an "inventory of water resources" throughout the country. Its language would seem to refer primarily to the storage and power opportunities that exist in our streams and lakes, perhaps also to navigation possibilities. But obviously these purposes would require that stream gaging be resumed by the government on a much larger scale than attempted heretofore, and this gaging work would give fuller knowledge of stream-flow

variation and would bring together a mass of data bearing on the frequency and magnitude of floods. Indirectly, therefore, the bill would lead to flood study, as a byproduct of its main purpose. Although the subject is by all means worthy of investigation first-hand rather than as a mere incident of an inventory of water resources, no flood study bill has been introduced, whereas the water resources bill is actually before Congress. Present hopes of assuring a beginning of the important preliminary to doing away with flood destruction therefore rest on the passage of the Newton bill. It is worthy of all the support engineers can give it through appeals to their Congressmen, by way of their societies or individually.

Problems of Contracting

ATTENTION is attracted by the number of papers on problems of the contractor that came before the Road Builders' meeting at Cleveland last week. The prominence of this part of the program might suggest that highway contractors have more serious difficulties than other contractors, but we doubt if such is the case. Most of the troubles discussed in these papers are incident to the contracting business quite generally. They were included in the group of essential present-day problems of the contracting industry which we indicated in our editorial review only a week ago. Properly, they should have been discussed at a meeting of contractors rather than a road builders' meeting, but the fact that they were aired at Cleveland proves that just now they are engaging an extraordinary amount of interest. This is a most hopeful sign. If the contracting group, on which the responsibility for ultimately solving the problems plainly falls, will attack them with enough energy and enlist the co-operation of highway engineers, general engineering societies and other interested agencies, it is certain that these latter will join in the work and help speed the advent of improved conditions.

Politics and Water Service

IN ITS water supply the city of Chicago seems to have a source of never-ending trouble, on account of political opposition to and interference with the plans of those competent to provide an adequate and safe supply. In quantity, the supply continues inadequate, due to uncontrolled use and waste, although many millions of dollars have been spent on additional intakes, pumping stations and mains. After years of advice and education as to the practical and economical value of metering the supply, a metering ordinance was passed, only to be nullified by passive resistance and non-enforcement, for political reasons. The outcome in this respect is still uncertain. In quality, the water is often dubious, safety being attained only by continual treatment with chlorine, sometimes at very high rates. When pollution of Lake Michigan by sewage and taste-causing industrial wastes reaches a high degree, as happened only recently, the combination of polluting and counteracting elements makes the water nauseating in smell and taste, even though rid of typhoid infection. If the city had the filtration system that was long ago planned and recommended, it would not have to rely entirely upon chlorination for the safety of its water. But the present policy of the authorities seems to be opposed to filtration as a remedy, although this is a measure within the city's own control. Instead, it is proposed to undertake a campaign for stopping all pollution of the lake. Such a campaign, even if carried on with persistence, must necessarily be of long duration, since it involves securing co-operation and action by several other cities, other states and numerous large industries, to say nothing of the federal authorities. An indirect and protracted movement, wise enough in itself, appears to be preferred to prompt and direct action which might produce earlier results in an improved water supply.

A Milestone

THIS week marks something of an epoch in the history of engineering in the New World. The American Society of Civil Engineers, first of the profession's technical organizations, is assembled for its seventy-fifth annual meeting. With characteristic modesty the board of direction calls the attention of the membership to this event by a few brief paragraphs in its report, but it is worthy of wider notice. The society has rounded out an honorable life of three-fourths of a century, and thereby has given proof of the sturdy vitality that alone makes possible so long a career. We offer our congratulations and our good wishes for a bright future.

In the existence of a society, as of a man, such an anniversary is a milestone. But it has rather different significance. For the man, 75 years means that youth with its vigor is gone and hoary old age is just ahead. For the society, the register of years carries a less direct meaning; youth or age may have been reached, growth or decadence may be ahead, but they must be read from other signs. What these tell is a matter that concerns not alone the society as an organization—the mechanism—but the whole constituency of men and interests joined together under its ægis.

The record of the past is one of honor. There has been consistent technical effort and achievement, supported always by a spirit that nurtured the best professional ideals and strengthened them for greater service. The present stands between that which has been achieved and that which is to be; it reveals strength and dignity, sincere purpose and wisdom of counsel; and there may also be discerned a nascent desire for more than bare technical activity. It is on these foundations that the future will be built.

What structure is to be reared thereon? The answer finally will depend on the changing part which engineering and engineers play in the world, and on the adjustment of society purposes and activities to these new conditions. Each day, we well know, engineering pervades the world's work more thoroughly, and the engineer's life becomes more closely interwoven with all human affairs. We see also that industrialization marches onward, and creates new relationships and responsibilities. We have seen how the profession of twenty-five years ago has become transformed into a different entity. It is possible, yes, quite probable, that the profession of today will hardly be recognizable twenty-five years from now. These things mean inevitable change in a society representing that profession.

Change and readjustment has indeed been the significant event of the society's past ten years. That period saw the beginning of a process of fitting the organism designed for a nation of fifty million to the demands of a hundred million. The adaptation has been accompanied by a large measure of success, and this is proper subject for congratulation on the present anniversary. But the

movement is hardly yet at an end. Differentiation of the profession in geographical distribution, in specialization and in functional arrangement has gone on faster than adjustment could follow or conservative judgment would readily admit. Revision and adjustment are bound to continue, we think, and in any event will be followed by other adjustments in the future. The world's rapid rate of physical growth today is evidence enough of continuous engineering change, and makes certain the need of future adaptation of society organization to meet its requirements.

The occasion of the society's seventy-fifth meeting means, then, that adaptation of purpose and method to the service of the profession as well as of the larger world which it serves constitutes the opportunity of the future. If the strength, the directness of purpose and the wisdom of leadership that now animate the society are always maintained, there is full assurance that the opportunity will be realized.

Ill Winds

DOES a great municipal undertaking always require a sudden jolt in the way of a serious human-interest catastrophe before anything really worth while is done about it? Cannot blasé public opinion be built up in some other way to rely on the accepted views of experts in the particular field as to what is certain to happen?

Late in the old year the Chicago Water Department served up "chloro-phenol cocktails" with such prodigality as to draw headline front-page newspaper notice several days. The cause of the trouble was an outpouring of phenol wastes by the industrial cities to the south of Chicago, mostly in Indiana, and a favorable wind to bring the pollution north into the Chicago water intake cribs. The control of the chlorination processes is such as to make the water perfectly safe for drinking, but to few householders is that much consolation when their children simply will not touch the nauseous liquid, and coffee and tea are ruined as beverages.

The Chicago district is in a difficult position. Having diverted its own wastes out of the watershed of Lake Michigan, its water supply is still not safe. A few hundred thousand people over the border in Indiana persist in using the common source of water supply as a receptacle for their domestic and industrial wastes. The Indiana towns are controlled by their industries. Sewage-disposal costs must be borne largely by the industries, which are the real offenders so far as the disagreeable tastes and odors are concerned. The towns themselves have "chloro-phenol cocktails" as a regular diet. They have been told time and again in engineering reports what must be done, but with the exception of Gary they have exhausted their legal bonding powers and up to now have refused to take advantage of provisions in the state law by which sanitary districts may be formed which would permit two or more to finance relief jointly.

Niggardliness of the powerful industrial taxpayers, jealousies of chambers of commerce, advice of consultants to go slow until "one more report" can be made, coupled with fear of profligate spending and unequal costs and benefits should a sanitary district be formed, all have held up any real progress at the lower end of Lake Michigan for five years. Now comes Chicago, fed with the same dose to which the Indiana cities have been accustomed, urging the Calumet cities to clean up or threatening to bring suit in the federal courts. The mayor of Chicago has appointed a commission to call in the officials of the offending cities. One meeting has been held, which seemed to develop a willingness to co-operate. The Chicago law department has started in to find grounds for beginning suit. Long ago the Indiana State Board of Health "ordered" the cities to clean up, and just recently it reaffirmed that order.

Thus do great engineering improvements get promoted. Submarines must sink before safety measures are provided. Thousands of automobile football enthusiasts must get stuck in the mud roads of Iowa before a hard-roads program is launched. Montreal must needs have a record-breaking typhoid epidemic before a supine administration wakes up to the necessary sanitary measures which modern research has long ago made available. A Mississippi flood loss of $200,000,000 starts the whole country on a search for control methods on a scale never before dreamed of. All of which indicates that engineers in research and survey fields probably will have to rely for many years on the activating influence of catastrophes to bring to actuality needed improvements of which their special knowledge has made them cognizant long ago.

Public Works Reorganization

WITH the present session of Congress, the campaign for reorganizing the federal government's public works activities seems to be finally nearing an end. For some time the movement has not been vociferous, and now its sponsors have receded from their demand for a separate department of engineering and construction; instead they propose that these functions be assigned to a bureau of the Interior Department. We believe that such an arrangement would threaten more injury and disorganization to the conduct of public business than any possible gain in co-ordination could balance. Were every government agency forced to depend for its technical advice and service—for its surveys, maps, designs, investigations, consultation, supervision and direction—on a single bureau of an already overcrowded and much-hampered department, the result would probably be disastrous, and engineering service might have to be dispensed with in many important matters.

With this unpromising outlook, it seems altogether likely that the whole reorganization movement will cease. It is not a particularly regrettable occurrence. The movement lacked vitality from its beginning, and had the obvious weakness of proposing a sweeping reconstruction of a highly organized mechanism, complex and delicate in its constitution. Our governmental organization has of necessity been a matter of evolution, growing as new functions called for specific new agencies. The interrelation and mutual dependence or independence of these several agencies are accordingly founded on an intricate fabric of conditions, both historical and present. That the Bureau of Public Roads is in Agriculture rather than Interior, that the Forest Service makes it own maps, that the Geological Survey expanded far outside its original scope and engaged upon functions of the Geodetic Survey, these and a multitude of like conditions are not necessarily amenable to arbitrary reorganization by diagram.

Some regrouping of functions or agencies may be useful, but this is not the present proposal. Wholesale rebuilding as contemplated in the public works department movement at no time engaged the strength of appeal necessary for success.

Construction Methods on Oakland Estuary Tube

Segments 203 Ft. Long Accurately Controlled and Accessible While Sinking 90 Ft. Below Surface—Changes in Original Scheme Simplify Work

By S. W. Gibbs
Associate Engineer with Francis Betts Smith,
San Francisco

A SUBAQUEOUS tunnel that has the largest diameter of any yet constructed is now nearing completion under the estuary between Oakland and Alameda, Calif. It is designed for vehicular and electric railway traffic and has a paved roadway surface 24 ft. wide in which are embedded two tracks with railheads flush with the paved surface. The total length, including approaches, is 4,436 ft. and between portals, 3,545 ft. Two-thirds of the length between portals, or 2,436 ft., consists of twelve precast concrete segments built in a drydock, floated to the site and then sunk to exact position in a cut or trench previously dug across the estuary bottom and provided with a suitable foundation. The tube itself as well as approach and portal structures are built exclusively of reinforced concrete. Construction of the 203-ft. segments was described in *Engineering News-Record*, Oct. 28, 1926, p. 692, and a description of the ventilation system was published March 10, 1927, p. 392.

The original construction plan was to carry the weight of the segments on reinforced concrete brackets of a thickness varying from 2½ to 5 ft. and spaced at intervals of 19 ft. 4 in. along both sides of each segment. These brackets, projecting 6 in. below the lowest part of the barrel, would be supported by a tremie slab 2½ ft. thick, which it was proposed to pour over the entire base of the dredged cut. The plan as finally adopted was to eliminate the tremie slab and all brackets (with the exception of those at the ends, adjacent to the joint) and to embed the segment barrels in sand.

The principal reasons for the change were: (1) The advantage of a continuous waterproofing membrane over the exterior of the structure, without the interference of brackets; (2) the elimination of a thin tremie concrete slab in a 100-ft. depth of flowing tidal water; (3) the advantage of continuous, uniform support offered by sand backfill beneath the barrel; and (4) decreased weight of the segments. Eliminating the brackets necessitated putting more reinforcing steel in the bottom of the barrel section.

The work of dredging the cut for the tube, which crosses the estuary almost at right angles, was begun in the latter part of 1925. The upper layer was taken out with a suction dredge and all material from depths exceeding 35 ft. below the water surface was removed by a clamshell dredge. The cut was completed in July, 1927, after the removal of approximately 850,000 cu.yd.

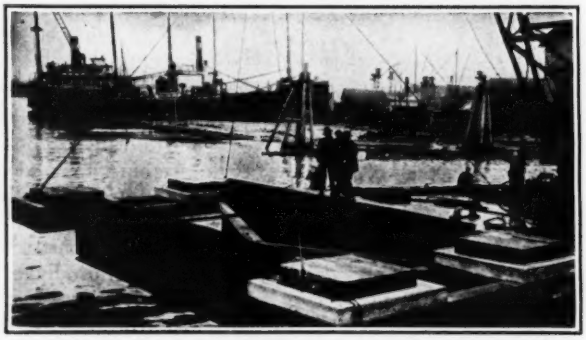


FIG. 1—LANDING FRAME READY FOR LOWERING
This frame, on piles, supports two segment ends until sand bed is placed. Steel diaphragms exclude sand while tremie concrete is placed.

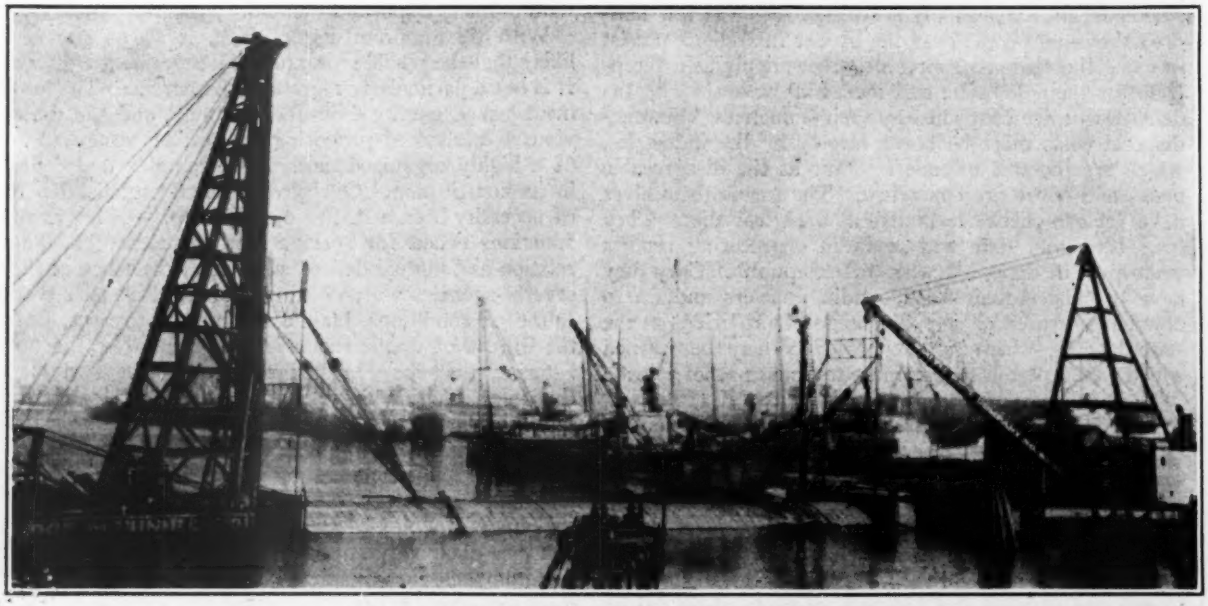


FIG. 2—SEGMENT F IN POSITION FOR SINKING
Crane and pile driver in position ready to take strain on bridles when buoyancy of segment is overcome by final water ballast.

In order to keep the cut free of mud it was necessary, throughout almost the entire construction period, to keep in service continually a scow with an 8-in. electrically driven centrifugal sand pump operated with the aid of divers. A fine silt carried by the tidal waters of the estuary collected rapidly in the open cut, mainly because

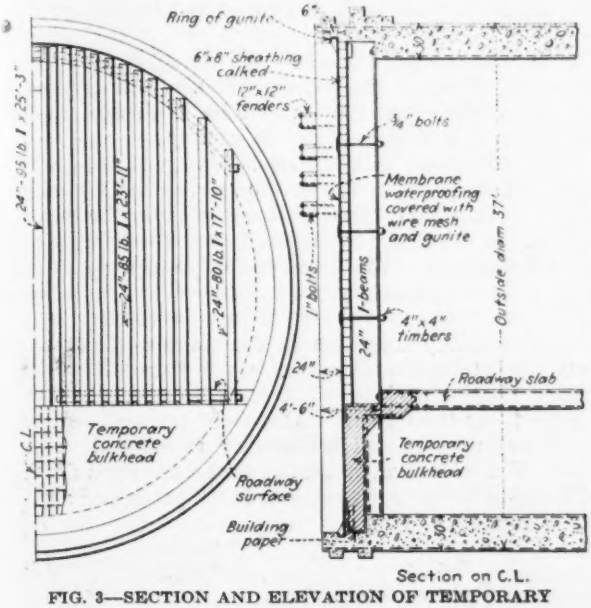


FIG. 3—SECTION AND ELEVATION OF TEMPORARY BULKHEADS

the cut extended about 60 ft. below the level of estuary bottom, thus providing a pocket with corresponding loss of velocity. Much trouble was also caused by the sloughing into the cut of the top banks and mud deposits on the side slopes. Because of these conditions a small derrick scow with a 1-cu.yd. bucket was kept busy continually in cleaning up the cut. At the Oakland end, where the segments connect with the cast-in-place section, quicksand was encountered.

At the Alameda end of the tube the underlying material was soft blue mud, extending about 90 ft. below water surface. For the two segments at the Alameda end this made necessary some means of support other than the sand bedding which was used on the firm ground. Accordingly, for a length of approximately 400 ft. of the tube in this location piling was driven in rows transverse to the cut, with 9, 10 or 11 piles in each row. The spacing between rows varied from 3½ to 7½ ft. All piles were driven to grade by a scow driver with 110-ft. leads, equipped with steel gins and steam hammer for under-water driving. In each case the gins in which the hammer worked were lowered directly to the bottom and the pile was driven to grade without the use of a follower. Between the rows of piles were placed light steel diaphragms which formed pockets for retaining the tremie concrete cradle. These steel forms were placed by divers, the depth of water here being about 55 ft. The completed concrete cradle was approximately 4 ft. thick, 65 ft. wide and 400 ft. long. It was reinforced by the steel forms and by wire rope also placed by the divers. The cradle as constructed is on a curve of 1,273-ft. radius, descends on a 4½ per cent grade and was kept at all points 3 ft. below the grade of the bottom of the segment barrel. This 3-ft. space permitted the placing of a sand cushion between the cradle and the segments.

The original design upon which the contract was let called for concrete grade piers in the bottom of the cut on which to land the segments and bring them exactly to grade. Four grade piers, 8 ft. in diameter, were to be provided for each segment, these to carry only a comparatively light load representing the weight of the segment in excess of its buoyancy. This plan was carried out for the first five joints, piers 6 ft. in diameter being constructed for the purpose in an open steel cylindrical cofferdam, 7½ ft. in diameter, which, after being driven down to the firm material, was pumped out and excavated so that the concrete grade piers would extend 4 ft. into firm material. On top of each of these piers a cast-iron sand jack was placed. After the segment was placed on these jacks and the sand bed put in, the jacks were lowered to transfer the load to the sand.

This type of landing pier was later discarded for a simpler and more efficient type, consisting of a framework of timber grillage and concrete, which was constructed on shore and lowered to place on piles previously driven to grade. Eight untreated piles were driven for each end bracket of each segment. When in place this grillage was 5 to 7 in. above grade, this being an allowance for settlement of the segment under the final loading. During this settlement the timber grillage was crushed and the load of the segment distributed over the sand bed throughout the length and width of the barrel.

In preparing the floating segment for sinking, the internal ½x3½-ft. air ducts, spaced 15 ft. apart on either side of the road slab, were closed and sealed by steel plates bolted and grouted into place so that there was no connection between the space above and below the road slab. It was essential that these ducts be tightly closed, as the water ballast had to be retained in a strictly confined and completely filled space to prevent the possibility of water hammer that might injure the segment or cause loss of control during sinking operations. A 6-in. standpipe at one end of each segment

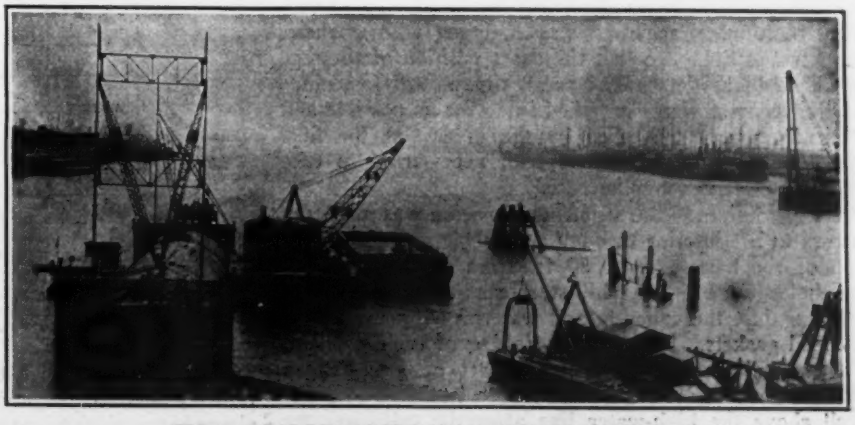


FIG. 4—LOADING SAND BALLAST INTO SEGMENT E
Segment lies at right angles to final position. Note protruding alignment masts of adjacent sections, also dolphins opposite joint.

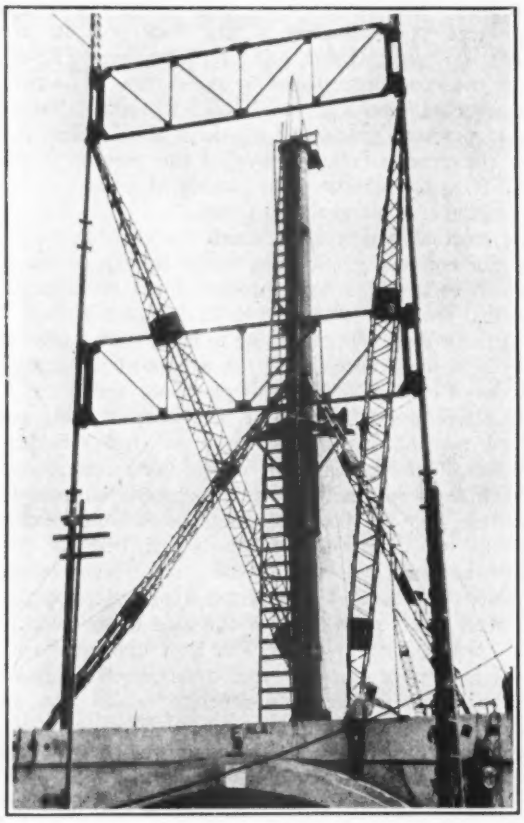


FIG. 5—ALIGNMENT MAST AND MANHOLE SHAFT

served to indicate when the invert space was completely filled and to show any loss due to leakage.

Below the road slab the temporary end bulkheads in each segment had been made of reinforced concrete in thickness varying from 12 to 18 in. Between the road slab and the exterior ring the bulkhead was made up of steel and timber.

Two alignment masts were erected at each end of each segment. These consisted of steel poles made up of pipe reducing in diameter from 6 in. at the base to 3 in. at the top. The two masts at each end were tied together by light steel trusses and braced from the top of the segment barrel with steel struts.

These masts were so set that when the segment was in place on the proper slope they would stand in a vertical position. Each mast was equipped with markers, targets and lights, so that the exact position of the segment could be determined at all times. All fastenings to the segment were simplified in so far as possible and their arrangement studied by the divers, as the final uncoupling of these fixtures had, necessarily, to take place below the water surface.

In the design of the segments provision was made for access to the interior through a manhole opening in the top of the barrel, about 50 ft. from the end. These manholes were fitted with steel castings made watertight against the concrete and waterproofing membrane by lead gaskets. Prior to the sinking of each segment, the manhole was fitted with a shaft of steel-flanged pipe 30 in. in diameter and of length sufficient to reach well above the high-water line after the tube was set to grade.

Pipes for water ballast, etc., were taken through the barrel of the segments independently of the manhole shaft. Through such openings dry sand for ballast was loaded into the floating tubes by clamshell buckets emptying into hoppers placed over the openings. About 950 tons of sand put into each segment by this means was later spread over the road slab area. This tonnage represented a sand depth of 3½ to 4 ft. over the entire road slab.

Before completing the placing of the sand, each segment was towed to a position above its final resting place, moored securely and the invert filled with salt water by siphoning it directly from the estuary.

With the invert full, the final loading of sand was given, whereupon the segment floated horizontally with about 1½ ft. of the barrel protruding above the water surface; in other words, the load very nearly equaled the displacement. The final loading to give the segment negative buoyancy was obtained by siphoning additional water onto the sand ballast. This water was held by capillary attraction in the voids of the sand, thus eliminating the danger of water hammer or the sudden shifting of ballast. The weight of water thus admitted was from 100 to 200 tons, or just sufficient to put a strain on the end bridles used to lower the segment. The table gives an idea of the loadings and depth of flotation for several conditions in the process of sinking a segment.

Condition	Depth of Flotation (Ft.)	Displacement (Tons)
Bulkheaded segment without ballast	26	5,400
After adding sand ballast	31	6,350
After adding water ballast	36	7,190
After adding water to sand ballast	37.66	7,261

With all the ballast listed in the table, the top of the barrel was just awash and any additional ballast represented a positive load.

Each segment was wired for lighting purposes as well as for the operation of motor-driven pumps within the segment. These pumps were to take care of leakage past the end bulkheads such as might develop when the exterior head was increased by the lowering of the segment, and also to pick up leakage from the invert and return it thereto. Segments were also equipped with telephone connections to expedite reports and orders concerning alignment and operation of pumps and valves.

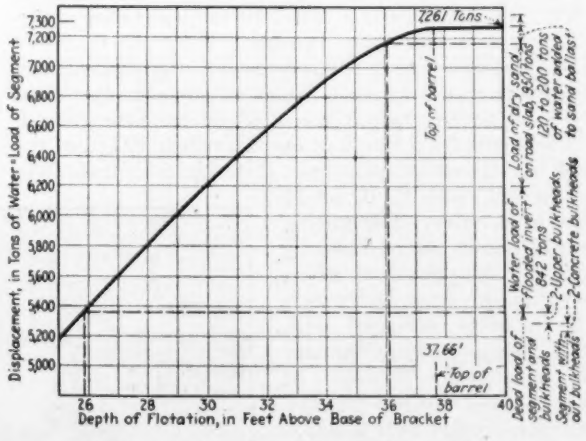


FIG. 6—LOAD AND DISPLACEMENT CURVE FOR SINKING SEGMENTS

With ballast and bulkheads removed, a backfill of about 2,100 tons (a fill of about 11 ft. above top of barrel) is required to overcome buoyancy.

The setting of all segments was controlled by a sys-

tem of head-, stern-, breast- and quarter lines of wire rope operated from hand crabs on dolphins. Vertical movements, after the placing of sufficient ballast, were controlled from a floating crane at one end and a large piledriver at the other end of the segment, by means of bridles around each end of the segment barrel. Studies of the estuary tidal currents showed that the maximum side thrust that might be expected from this source would be 80 tons for any one segment. Accordingly all lines, blocks, sheaves, etc., were designed for this loading and the loading reduced by means of sufficient runs of blocks to approximately 2 tons at each winch. In this way an easy slow movement of the segment could be obtained and lateral movement was accurately controlled with ease, particularly as the winches were mounted on rigid dolphins instead of on floating equipment. Dolphins were made up of 14 piles, ten of which were braced piles rigidly bolted under headers sized into the vertical piles. Great care was taken to secure firm, dependable dolphins on account of the danger which might have resulted from dolphin failure at the time of sinking.

Not only was it necessary that the dolphins have sufficient strength to take care of the 80-ton tidal thrust against each segment, but the effect of surge resulting from the wake of passing steamers was found to produce a tremendous additional strain not susceptible of exact analysis. In one instant as the segment was moved slightly by such a surge, a 10-in. oak toggle block was completely sheared through by a mooring cable. On other occasions several runs of 1-in. wire rope were snapped in two. Aside from some slight delay, however, these accidents had no serious consequences.

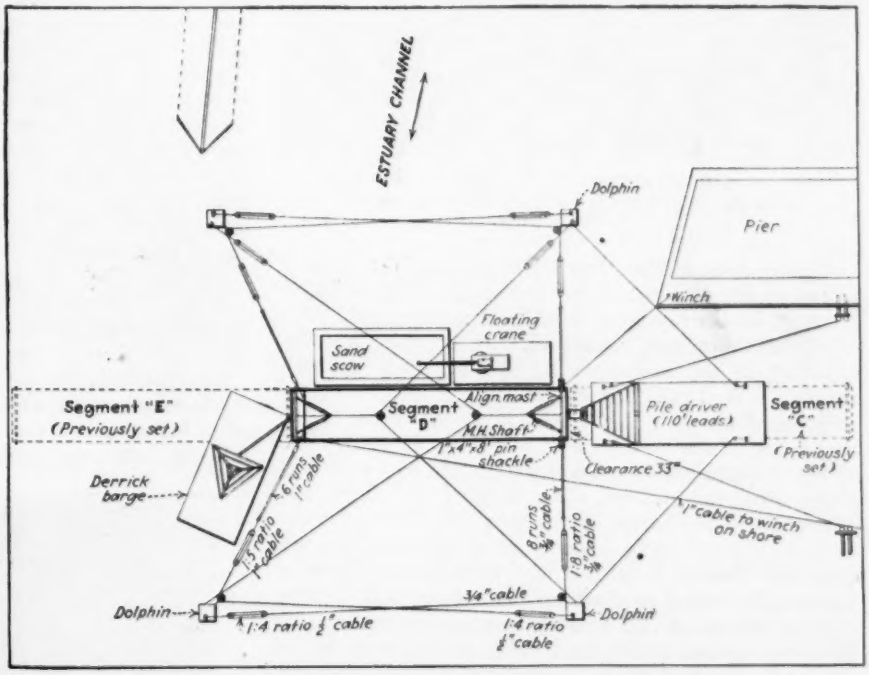


FIG. 7—PLAN OF CONTROL CABLES FOR SINKING LAST SEGMENT

The bridles around the barrel at each end of the segment to control vertical movement were made up of wire rope of 6½-in. circumference. These were coupled to a run of blocks on the floating driver at one end of the segment and to the floating crane at the other. The total available lifting capacity for an emergency was 400 tons; need for using this full capacity, however, was avoided by careful ballasting and provision for handling leakage through bulkheads.

With all ballast placed and rigging set, the actual sinking and setting was ordinarily accomplished in less than two hours. During this time alignment masts were continually checked by instruments on shore, so that the precise segment location was always known. The top of the end ring of each segment was provided with a reinforced concrete beveled key to assist in lining up adjacent tubes as they came together. The final setting of tubes was further aided by diver inspection to assure proper joint conditions.

Immediately after being set in the correct location, segments were given an additional load of interior water ballast upon the sand to prevent any possible displacement from tidal thrust, or from wedging action of the sand bed as it was being placed.

The exterior sand bed was placed by pumping sand previously mixed with water through a 6-in. hose which manifolded into two 4-in. lines, one delivering beneath each side of the segment under the direction of divers. Each segment was carefully bedded, working from center toward the ends, the steel joint form having been placed prior to sanding the ends. Upon completion of the sand bed, additional water was admitted to the segment until finally it was completely filled. All during this period and for several weeks following the alignment masts were closely watched by instruments on shore to observe the resulting settlement. With the sand-jack type of joint, it was necessary first to release the jacks before giving the final load of water, but with the improved type of joint using a timber grillage, this timber merely crushed as the segment settled into the sand bed under the increased load. A leeway of one inch from true alignment of line and grade was permitted in the placing of segments.

In the event that it was desired to lower a segment which of its own flooded weight did not settle sufficiently to come within the permitted allowance, it was necessary to hydraulic out a portion of the sand bed to produce further settlement. By removal of a greater amount of sand from one side than from the other, lateral movements of segments could also be obtained, care being taken to prevent a transverse list or cant in the tube. Obtaining extremely slight movements of an embedded segment had to be carried on with great care, for considerable sand had necessarily to be removed before any initial settlement would begin and once started immediate resanding was imperative to check excessive movement. All of the operations were accompanied by changes in the water ballast content of the segment, this being suited to the requirements of each case.

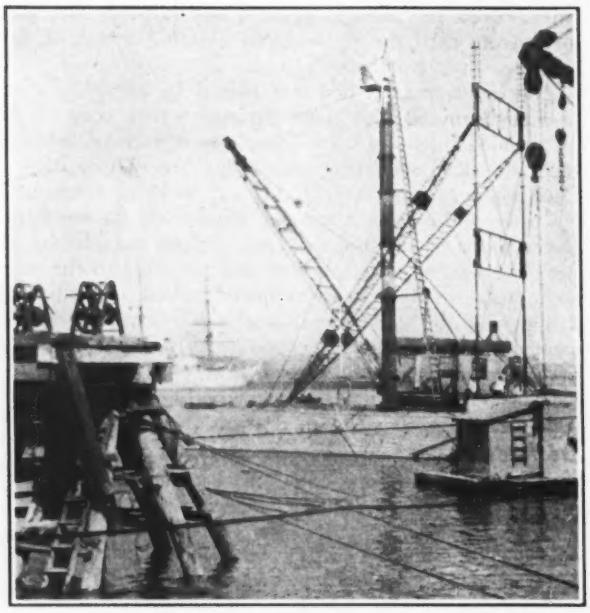


FIG. 8—DOLPHIN BRACED WITH BATTER PILES
Alignment masts and manhole shaft of Segment F in background.

During construction, two slides occurred in the side banks of the cut, dislocating segments which had been set to place but not completely bedded with sand. One of these slides was almost directly opposite a joint, resulting in the movement of two segments approximately 18 in. from their correct alignment. After the removal of the slide a spring buck was set in the trench at the side of the barrel. This was made up of two sets of heavy timbers and steel plates separated by ten double-coiled steel car springs. One side of this buck was curved to fit the barrel of the tube while on the other side of the springs the groove for the driving of sheet piles was beveled in such a way that the driving of a wedge pile tended to close up the springs and exert a constant thrust of 200 tons against the segment. This buck was backed up by sheet piling carried over to the side bank, the wedge pile being the closure pile in each row. By this means, supplemented with additional wedge piles against the end brackets, the segments were successfully shoved back to their proper position.

It was necessary to use a considerable number of divers in connection with the tube work, as many as seven often being down during the day. The greatest working depth was about 100 ft. Safety measures were observed strictly and the work was done without serious accident to any diver. Divers were decompressed or raised to the surface gradually according to a schedule providing a definite period of decompression for a specified working period at a stated depth. A decompression period of one hour was required for a two-hour working period at a depth of 100 ft.

The first of the twelve precast segments in the tube was set adjacent to the Alameda portal building and the work proceeded down grade (northward), until eight segments had been placed. At this time the tube extended about 55 ft. beyond the center line of the estuary. During this period the south channel was kept closed to steamer traffic. The next segments were set at the Oakland end, working southward from the end of the cast-in-place subway which had been constructed in an open-cut cofferdam carried down 72 ft. below the surface. Upon completion of this cast-in-place work, the end was fitted with a watertight bulkhead, water was admitted to the cofferdam, the dredging was completed and the end section of the cofferdam was removed. From the Oakland end four segments were then set, the last being the closing segment. This sequence in placement was selected because, although most of the segments rest on a grade, this final segment sets in a practically level position, thus simplifying closure at this point.

In casting the segments in the drydock the clearance allowed for placing this last segment was 3 ft., and the final joint was made by bolting a steel band around the barrel of the two adjacent segments, this serving as an interior form for the joint concrete. (At all other joints a canvas belt 12 in. wide was used in making this inner form.) After the final segment was set, divers measured the closure space and found it to be 2 ft. 8½ in. as compared with the original allowance of 3 ft.

The distance between the end brackets of adjacent segments is 6 ft. A semi-cylindrical steel sheet, with mate sections of interlocking steel sheet pile riveted to the two vertical edges, served as an exterior form for the tremie concrete at each joint. This form was of a length sufficient to extend to the base of the cut as well as to the top of the bracket and hence also served to keep the joint free of the bedding sand. Before pouring, joints were thoroughly cleaned out and a cross form was placed at the bottom of the joint. In this way the 210 cu.yd. composing the tremie joint was made in two separate pours, one-half being completed before starting to pour on the other side.

Before unwatering or removing ballast from a segment it was necessary to place sufficient backfill above to overcome buoyancy, as the weight of each 203-ft. segment is about 5,500 tons, while the displacement is 7,261 tons.

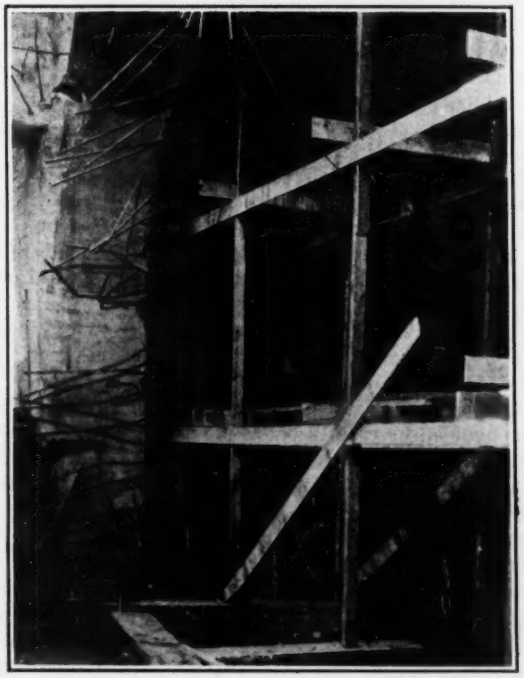


FIG. 9—INTERIOR OF JOINT BETWEEN SUBMERGED SECTIONS
After roughening surfaces, cleaning and lapping the steel rods, a ring of concrete is poured to complete the joint.

When this article was written, six segments at the Alameda end and one at the Oakland end had been opened up. As each joint becomes accessible on the inside it is thoroughly cleaned and after lapping the projecting reinforcing steel, which serves to tie together the barrels of adjacent segments, the interior joint ring of concrete, 1½ ft. thick by 8 ft. long, is poured. The steel and timber bulkheads were so constructed that they could be removed through the tube itself without cutting the 24-in. steel I-beams. An electric locomotive operating on industrial track hauls the sand ballast to the portal building.

Subsequently the concrete ceiling slab of the roadway is constructed, this being the floor of the exhaust air duct, with transverse air vents at 15-ft. intervals throughout the length of the tube. The road slab also has to be completed at the joints, and sidewalks, curbing, gutters, railing, etc., have to be constructed throughout the length of the tube.

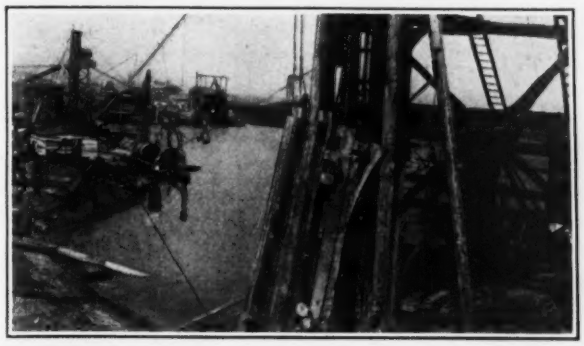


FIG. 10—SPRING BUCK USED FOR RESTORING ALIGNMENT
When mud slipped into the trench and displaced segments, this device, thrust over by a wedge shaped pile, was used to move them back.

On Dec. 1, 1927, about 1,500 ft. of the tube structure had been completed at the Oakland end, comprising the approach, portal building foundation and cast-in-place subway. The Alameda portal building foundation was complete and the Alameda approach practically so. These structures were constructed in open cofferdams, those in Alameda being on piling above a layer of mud approximately 90 ft. thick.

With all precast segments in place, and the tube soon to be completed and ready for use, this type of construction has proved to be entirely feasible and very economical for locations where it is practicable to maintain an open trench in the existing water currents. Its cost is roughly one-half the cost of a similar tube constructed by the common shield method.

Contract for the work was let in March, 1925, to the California Bridge & Tunnel Co. of San Francisco, and actual construction commenced in June, 1925. Work will be completed in the early part of 1928, well ahead of the contract time of 900 working days. A. J. Crocker is president of the California Bridge & Tunnel Co. and Francis Betts Smith is consulting engineer. David E. Root is superintendent of construction.

The work is being done for the County of Alameda, with George A. Posey, county surveyor, as chief engineer of the project, and Lochiel M. King, engineer of construction. Professors Wm. H. Burr, Charles Derleth, Jr., and the late C. M. Holland have served as a board of consulting engineers on design.

Single Water-Works Pump Arranged to Serve in Place of Three

A PUMP having three separate suction and discharge lines is in use at a small water purification plant recently completed at Merritton, Ont. The pump, which is driven by a gasoline engine, was primarily installed as a wash-water pump to duplicate a 1,500-Imp. g.p.m. electrically-driven unit, although provisions were made for using it for other purposes.

Water for the 1.5-Imp. m.g.d. filtration plant is pumped from a branch of the Welland Canal into sedimentation basins, from which point the settled water flows by gravity through pressure filters into an open filtered-water reservoir. From this reservoir the water is pumped to the city, although the head is large enough to supply all but a small section of the city and pressure-reducing valves are used on the major portion of the supply. Sufficient head to wash the filters is not available in the filtered water supply, so the installation of the two wash-water pumps mentioned was made.

The three suction lines to the gasoline-engine-driven wash-water pump are connected (1) to the canal, to bring raw water to the sedimentation basins, duplicating the raw-water pump; (2) to the sedimentation basins, to force settled water through the filters in case the gravity head from the basins to the filters is insufficient; (3) to the filtered water reservoir, to pump water through the filters for washing purposes.

In addition to these uses the pump may supplement the main pump which supplies the city with water directly from the filtered water reservoir.

The foregoing information is taken from an article on the purification works at Merritton, in the *Contract Record and Engineering Review* (Toronto, Ont.) for Dec. 28, 1927.

Emergency Stations to Check Flood Damage

The Los Angeles County Flood Control District will have the advantage during the flood season this year of seventeen emergency field headquarters, each in charge of an experienced man and equipped in advance to combat dangerous floods. The scheme is merely one of preparedness to minimize or altogether avoid serious property damage by advance provision for getting protective or repair work under way with as little delay as possible when flood danger threatens or a break occurs. The operators stationed in the field headquarters are foremen who have had charge of construction and each of whom is familiar with conditions in the district to which he is assigned. The field stations are provided with telephones and operators report to the chief of maintenance in the Los Angeles office. Repair crews will not be maintained continually at each of the field headquarters but plans have been made for getting crews to these several points with a minimum delay in any emergency. Materials needed in checking flood menaces will be stored at each station.

This preparedness plan is desirable, according to E. C. Eaton, chief engineer of the Flood Control District, because as yet only a portion of the flood control work has been completed and in previous flood seasons considerable damage has been caused by breaks before effective remedial measures could be taken.

Column Deflection Method for Designing Lateral Bracing

Lateral Moments Distributed Among Columns in Their Ratio of Rigidity, a Function of Length and of Moment of Intertia

By John C. Van der Mey and Felix H. Spitzer
Consulting Engineers, San Francisco, Calif.

THE attention of structural engineers on the Pacific Coast has been focused for some time upon bracing against lateral deflection in steel buildings. This is because of a tendency to make changes in the allowance for wind loadings and because lateral bracing is the most important element in improving the earthquake-resistant quality of steel structures. In this article the authors submit a means of determining the necessary lateral bracing for any assumed loadings, using a method that is based on the deflection of the columns. The claim is made for this method that it is (1) workable; (2) economical, because all the columns of the building are considered in the ratio of their strength to resist deflection; and (3) more consistent with conditions that actually obtain in a building submitted to lateral loadings which cause deflection in the columns than in the three methods of designing against horizontal loadings that are in common use.

The three workable methods referred to, which are the only ones known to the writers to be in general use, are those described by A. C. Wilson, in *Engineering Record*, Sept. 5, 1908, and by R. Fleming in *Engineering News*, March 13, 1913, p. 492. In Wilson's method, sometimes known as the cantilever method, the building is considered as an entirely rigid and homogeneous cantilever. On this assumption, the direct stresses in the columns are found and from these are derived the shears in girders and columns. The accuracy of this method is doubtful because a structural steel frame consists of flexible columns and girders so that Hooke's law cannot properly be applied in deriving the stresses.

The other two methods are described by Fleming and are known as the portal and the continuous portal methods, respectively. They are based on the assumption that the horizontal shear in any plane is equally distributed among the columns cut by that plane, an arbitrary assumption doubtless made because it leads to an easily workable method.

Bending Stress Calculations—When the steel frame of a building is submitted to lateral loading, assuming the floor to be a rigid plane and rigidly connected to the columns, all columns of the frame will deflect and the deflection between any two floor levels will be the same for all columns inside their clear length. This is shown diagrammatically in Fig. 1.

To derive equations for shears and bending stresses in the columns, two assumptions are necessary, (1) that

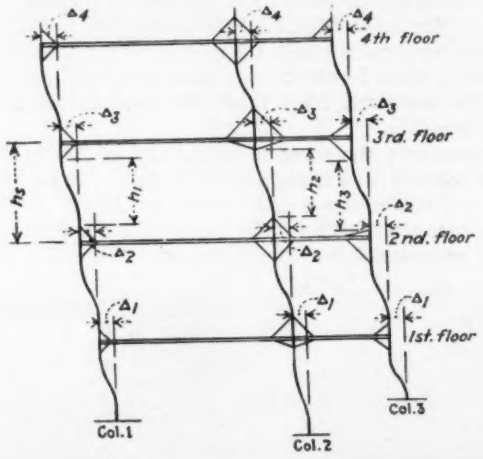


FIG. 1—DEFLECTIONS IN A BUILDING FRAME SUBMITTED TO LATERAL LOADING
All columns between any two floor levels deflect equally.

girders and girder connections are non-flexible, and (2) that the length of the girders connecting the columns remains unchanged after deflection. Furthermore, in the opinion of the authors, no method of analyzing bending stresses would be feasible that took into account the actual moments of inertia of columns, beams and girders. With these assumptions, equations for bending stress and shear are developed with the use of the following nomenclature:

$c_1, c_2, \ldots c_n$ = distance from center line of gravity to extreme fiber
$I_1, I_2, \ldots I_n$ = moment of inertia about center line of gravity
$f_1, f_2, \ldots f_n$ = bending stress in extreme fiber
$h_1, h_2, \ldots h_n$ = clear length of column between points of rigid connection
ΣH = total shear at floor level. This is either the total wind load at the floor level or is a function of the load on the columns as fixed either by building ordinances or by regulations of earthquake insurance underwriters

TABLE OF CALCULATIONS FOR COLUMN SIZES OF BUILDING FRAME IN FIG. 3. (STORY HEIGHT h_2 = 12.5 FT.)

			Loading N–S						Loading E–W						
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Col. No.	Direct Load Kips	Shape of Cols.	e in.	I	h ft.	I (equiv.) $=I\times12.5^3$ h^3	$f=\frac{K\times e\times12.5^2}{h^2}$	e in.	I	h ft.	(I equiv.) $=I\times12.5^3$ h^3	$f'=\frac{K'\times e\times12.5^2}{h^2}$	f (max.) = Direct + Lateral Load	Revised Col. Shape
1	119	10 H 49.5	5	89	7.5	410	7.5	5	264	8.0	1000	10.0	18.3	10 H 49.5
2	248	12 H 85.5	6	229	9.0	610	6.2	6	676	8.0	2560	12.0	22.0	12 H 106
3	188	12 H 65.5	6	169	7.5	775	9.0	6	499	8.0	1900	12.0	22.0	12 H 79.0
4	335	12 H 113.0	6.3	933	7.0	5250	10.4	6.1	314	10.0	610	7.8	20.4	12 H 119.5
5	390	12 H 133.5	6.2	381	9.5	870	5.8	6.5	1141	9.0	3060	10.2	20.2	12 H 133.5
6	239	12 H 79.0	6	616	7.0	3500	10.3	6	208	10.0	400	7.7	20.3	12 H 85.5
7	205	12 H 72.5	6	557	6.5	4000	12.0	6	188	8.3	630	11.0	22.0	12 H 85.5
8	378	12 H 126.5	6.1	358	9.5	810	5.7	6.5	1070	8.3	3600	12.0	22.0	12 H 140.5
9	298	12 H 106	6	867	6.5	6200	12.0	6	292	8.3	1000	11.0	22.0	12 H 119.5
						22,425 = ΣI (equiv.)					14,760 = ΣI (equiv.)			

$\frac{2400}{15} = 160{,}000 = \Sigma H$

$K^1 = \frac{12.5\times12\times160{,}000}{2\times22{,}425} = 535$

$K' = \frac{12.5\times12\times160{,}000}{2\times14{,}760} = 815$

$H_1, H_2, \ldots H_n$ = shear at col. 1, 2, ... n
$M_1, M_2, \ldots M_n$ = bending moment at col. 1, 2, ... n
D = deflection of columns
E = modulus of elasticity
h_s = story height or any other convenient height

Assuming the point of contraflexure at the center of the column height,

$$D = \frac{H_1\left(\frac{h_1}{2}\right)^3}{3EI_1} = \ldots\ldots \frac{H_n\left(\frac{h_n}{2}\right)^3}{3EI_n}$$

Eliminating constants:

$$\frac{H_1}{\frac{I}{h^3}_1} = \frac{H_2}{\frac{I_2}{h^3_2}} = \ldots\ldots \frac{H_n}{\frac{I_n}{h^3_n}} = \frac{\Sigma H}{\Sigma^n_1 \frac{I}{h^3}} \qquad (1)$$

and

$$H_1 = \left(\frac{I_1}{h^3_1}\right)\left(\frac{\Sigma H}{\Sigma^n_1 \frac{I}{h^3}}\right) \ldots\ldots H_n = \left(\frac{I_n}{h^3_n}\right)\left(\frac{\Sigma H}{\Sigma^n_1 \frac{I}{h^3}}\right) \quad (2)$$

$$f_n = \frac{M_n c_n}{I_n} = \frac{H_n h_n c_n}{2 I_n} = \left(\frac{c_n}{2 h^2_n}\right)\left(\frac{\Sigma H}{\Sigma^n_1 \frac{I}{h^3}}\right) \quad (3)^a$$

This is the general equation for the calculation of the bending stresses in the columns. To simplify calculations in the design of buildings the height h_s and the I (equiv.) have been introduced:

$$I_{\text{(equiv.)}} = \frac{I_n h^3_s}{h^3_n}$$

$$\text{then } f_n = \left(\frac{h^2_s c_n}{h^2_n}\right)\left(\frac{h_s \Sigma H}{2 \Sigma I_{\text{(equiv.)}}}\right) = \left(\frac{h^2_s c_n}{h^2_n}\right) K \quad (3)^b$$

In the special case where the clear height is the same for all columns

$$f_n = c_n \times \frac{h \Sigma H}{2 \Sigma I} \qquad (4)$$

Similarly, in the special case where one or more columns are continuous for two or more stories, as would occur with a mezzanine floor, and as illustrated in Fig. 2, the same general theory applies. As the deflection of such a long column is the sum of the deflections in the several short columns that make up the same total length, the shear in the long column is the sum of shears calculated for each story, using the height h_3 in the calculations for each story. Consequently, the bending stress in such a column is the sum of the bending stresses calculated for each story. As the deflection will be approximately in direct ratio to the story height, the bending stress in such a column will be approximately:

$$f_3 = \frac{h_s c_3}{h_3} \times \frac{h_s \Sigma H}{2 \Sigma I_{\text{(equiv.)}}} \qquad (5)$$

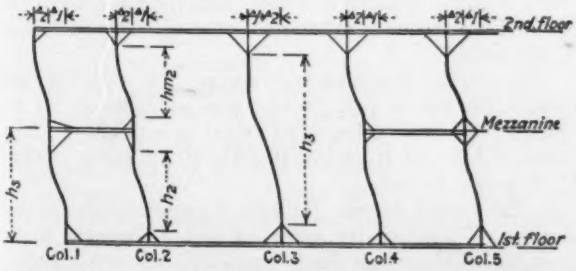


FIG. 2—DEFLECTIONS IN A BUILDING FRAME HAVING SEVERAL COLUMNS CONTINUOUS OVER TWO FLOORS
Bending stress in long column is sum of bending stresses for each story.

Typical problem—To give a detailed illustration of this method, a typical problem is worked out in the following, with the aid of Fig. 3. Assume a building to be 37 x 42 ft. in plan with the total weight of eight stories as 2,400,000 lb. The steel frame is to be designed to safely resist earthquake loadings equivalent to one-fifteenth of the total weight, or 160,000 lb. The safe working stresses in the columns are to be 15,000 lb. per sq.in. for dead and live loads and 20,000 lb. per sq.in. for combined, dead, live and lateral loads.

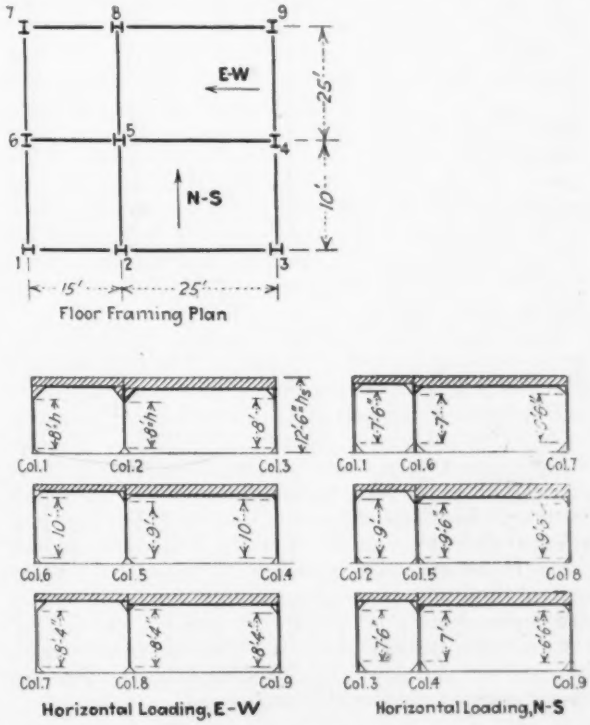


FIG. 3—PLAN AND ELEVATIONS OF BUILDING FRAME SUBMITTED TO LATERAL N-S AND E-W LOADS

The design of a building frame by column deflection requires a preliminary selection of the shape and the establishment of the clear height of the columns. The shape of the columns is selected with respect to dead and live load so that the combined unit loadings will be about 20,000 lb. per sq.in. This may be done either by a rough calculation of the bending stress in an average column of average height or by judgment, taking an upper or a lower column tier as a gage. Assume the average bending stress to be say 10,000 lb. sq.in., leaving 10,000 lb. sq.in. for the direct stress.

A table, as reproduced, is now prepared for convenience in listing the various values as they are determined. The table is largely self-explanatory. The combined direct stress and maximum bending stress with

loading either N-S, or E-W, is given in col. 14 of the table. If necessary the direct wind stress is added to it. The revised column shapes in (15) are determined from the maximum stresses in (14) by increasing or decreasing the preliminary shapes in (3) approximately in the ratio of maximum stress / 20,000, if all columns change in approximately the same ratio, or by changing the preliminary shape in the ratio of 10,000/(30,000-maximum stress) if only one column shape has to be changed. The latter formula gives the greater value. The moment in the columns will be the bending stress given in (8) and (13) multiplied by the section modulus of the preliminary column size.

Incidentally it is to be noted that in order to get an economic design, the ratio of $I_{(equiv.)}$ for N-S loading to $I_{(equiv.)}$ for E-W loading should be approximately the same as the ratio of the total lateral shear in these two directions if the clear column heights are all the same. If the column heights are different, the most economic design is obtained if $I_{(equiv.)}$ in both directions is maximum and if the total necessary increase of the column shapes for N-S loading is approximately the same as the total necessary increase of the column shapes for the E-W loading.

It is also to be noted that the increase of the size of one column say from 12 in. to 14 in. will increase the fiber stress in that column, but at the same time will decrease the stresses of all other columns. The same is true for shortening the column height by bracing. Long columns, even when continuous over two or more stories, will have less bending stress than the typical columns. For these reasons in an economic design the column sizes for one tier should, if possible, be the same, if the column heights are the same. If bracing is used, it should, if possible, be applied to all columns, and approximately with the same height, making the clear column heights uniform. The same size should be used for the shorter and braced columns. For the longer columns a longer size can be used.

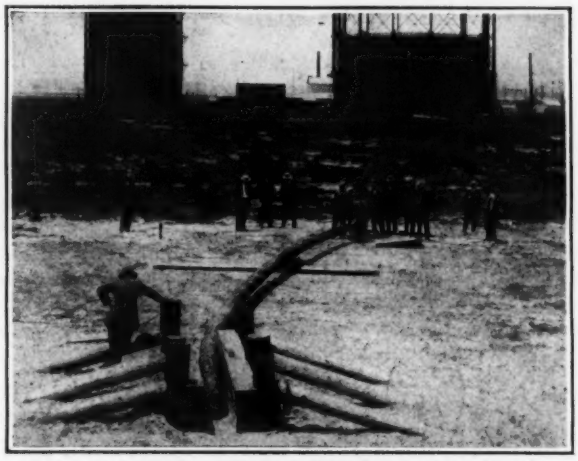
Maximum Load for Treated Poles Measured in Test Series

Load Applied as Side Pull at Top by Locomotive Crane and Measured by Dynamometer Placed in Pulling Line

A SERIES of tests on Douglas fir poles treated according to the present standard specifications of the Creosoted Douglas Fir Pole Producers was conducted recently at Long Beach, Calif. The average modulus of rupture for all poles was 9,815 lb. per sq.in. Tests were made of five of each of the following lengths: 35 ft., 40 ft., 50 ft., 55 ft., 60 ft., 65 ft. and 70 ft.

The testing methods and principles followed were those developed by the U S. Forest Service. The poles were placed in a horizontal position with the butt end held between heavy posts set in the ground. The load was applied as a side pull at the top end of the pole by means of a cable which was attached to and operated by a locomotive crane. The load was measured by a dynamometer inserted in the line near the pole, the dynamometer having a capacity of 10,000 lb. It was calibrated before and after the tests, and proper corrections made for readings. Deflections from the normal position of the pole were measured by a steel tape. Gradually increasing load readings with their corresponding deflections were taken up to the maximum breaking load. In order to prevent friction the top end of the pole was supported on a dolly placed about one-third of the distance from the top to the point of support, the latter corresponding to the ground line when the pole is in place.

The modulus of rupture is defined in a service bulletin, entitled "Results of Strength Test on Wooden Poles," by T. R. C. Wilson as "the computed maximum stress in the pole at the maximum load. The point at which this maximum stress occurs depends on the taper of the pole. If the taper is such that a diameter of one and one-half times that at the top reaction, corresponding to the point of attachment of a single cross-arm or to the point where the pull of the wires is centered when more than one arm is used, is found above the ground line, then the maximum stress is at this point of one and one-half diameters. When the taper is less than this, the maximum stress is at the ground line. The relation



TESTING POLES BY APPLYING SIDE PULL LOAD NEAR TOP
Side pull was applied by a locomotive crane not shown in the picture. Load was measured by a dynamometer inserted in the line near the pole

between maximum stress and top reaction (load at top) is given by the following formula:

$$\text{Maximum stress (lb. per sq.in.)} = \frac{L \times \text{load at top}}{0.098\ D^3}$$

where L is the distance in inches from the top load to the point of maximum stress and D is the diameter in inches at this point."

The average modulus of rupture for each of the various lengths of poles tested was as follows: 70 ft. poles, 7,895; 65 ft. poles, 9,687; 60 ft. poles, 9,514; 55 ft. poles, 10,419; 50 ft. poles, 10,250; 40 ft. poles, 9,394; 35 ft. poles, 11,548.

In the Forest Service Bulletin referred to above, the modulus of rupture for green untreated Douglas fir is given as 6,300 for not dense and 7,300 for dense poles. All the poles tested were dense, having more than six annual growth rings per inch as measured over the outer two inches of the radius of the butt end of the poles. There was only one pole of those tested which did not break at or near the ground line. The tests were made by the Smith-Emery Co., testing engineers, Los Angeles, Calif.

Oiled Subgrade Stops Frost Boils in Gravel Roads

Oiling Clay Roadbeds Reduces Spring Break-up, Lessens Loss of Gravel by Submergence, Diminishes Dust

By H. G. Nicholson
Assistant Engineer, Minnesota Department of Highways, St. Paul, Minn.

IN 1925, due to the evidence of a diminishing supply of gravel and also to the inherent characteristic of certain subsoils to "eat up" gravel, experiments on gumbo and clay were tried in Minnesota in the hope of waterproofing the grade so as to hold the gravel up and the water out. It was hoped that gravel consumption could be reduced and the road made more serviceable during all seasons of the year. Especially in the gumbo, during the spring and fall, roads even with 1,600 cu.yd. of gravel per mile are almost impassable. The rains and spring "break-ups" make these roads muddy, sticky and rutted thoroughfares requiring an excessive expenditure to get traffic through. Oftentimes the mud holes or "frost boils" have to be planked to make the roads serviceable.

The first attempt toward solution of this problem was the use of a road oil applied in two applications of about 0.3 gal. per square yard. This oil was not covered with gravel and difficulties were encountered which discounted the method, but the mere fact that the oil did waterproof the road and did stiffen or toughen the crust encouraged the highway department to go further. The outstanding difficulty of the process as first tried was inability to prevent the "picking up" of the oil, more especially by steel-tired vehicles. These roads are in rural communities and steel-tired vehicles are numerous. Then, too, a road that is oiled and not covered with gravel develops a slippery surface which introduces a hazard, especially in wet weather. The cost of patching and maintenance is higher on this type of surface, and scarifying has to be done more frequently, which requires more oil.

At the same time that the experiment referred to was being carried on, several other experiments on clay and gumbo were made, using varying amounts of oil and gravel for a covering material. The results were encouraging, and the following year oiling subgrades on a large scale was started.

Original Treatment—The roadway to be treated is first allowed to take traffic for some time, thereby bringing out the weak spots. These defective areas, sags or pockets of non-uniform material are filled with the prevailing clay or gumbo, and the roadway is then subjected to concentrated blading or planing to create a very smooth surface. The inherent ability of this class of soil to pack and harden soon has the roadway in a uniform, smooth condition. While this operation is in progress, gravel is windrowed along one shoulder of the road at a rate of 350 to 450 cu.yd. to the mile ready to be bladed over when the oil is applied. The composition of this oil is as follows:

Oil shall be free from water	
Specific gravity	1.034
Flash, deg. C.	156
Specific viscosity	13.8
100-penetration residue	65.6
Ductility of residue	100+
Loss at 163 deg. C.	3.2
Total bitumen soluble in CS_2	99.90
Total bitumen insoluble in 86-deg. naphtha	14.52

When the road is shaped and *dry* (dryness cannot be emphasized too strongly), the application of oil is started. Half of the roadway is treated first with a prime coat of as much oil as the material will absorb. This usually is between 0.35 and 0.55 gal. per square yard. It is applied with a power distributor at a temperature of 175 to 200 deg. F. When this oil has penetrated so that it will not pick up, traffic is allowed to use this side of the road and the prime coat is applied on the other side.

After the entire roadway has received the prime coat and is dry, a seal coat is applied, starting on the side of the road first primed, which is also the side on which the gravel is windrowed. The application of the seal coat can be at a lower temperature, about 160 deg. F., and at the rate of 0.3 to 0.35 gal. per square yard. As soon as the seal coat is applied, or within half an hour afterward, a power patrol equipped with rubber tires and a 12-ft. blade pulls the gravel over the oiled surface. The entire surface is covered in this manner and the roadway is then ready to carry traffic.

A thin layer of gravel is kept floating over this surfacing and with the exception of a slight discoloration the road exhibits all the characteristics of an ordinary gravel road. Maintenance on this type of road, consisting of blading and planing, is started at once and is carried on consistently. However, the patrol sections are lengthened and one patrolman can successfully handle 20 miles instead of 6 to 10 miles. In some cases power patrols are used, but in most cases spring blades mounted on trucks are found very satisfactory.

Second-Year Treatment—During the second year the roadway is bladed free from loose material and a light application of the same kind of oil as is used the first year is applied at the rate of 0.2 to 0.3 gal. per square yard. This is again covered with a thin coat of gravel. About 125 to 150 cu.yd. to the mile of additional gravel is needed as a cover coat. In places where break-ups have occurred or where extreme roughness is in evidence a light scarifying will remedy the difficulty with little additional cost.

The cost of this treatment ranges between $1,200 and $1,800 per mile the first year, and half of the original amount the second year. In some cases the third year can go without any treatment, but it is usually advisable to repeat the second-year treatment. The conclusions from experience with subgrade oiling may be stated as follows:

1. For the class of road developed it is cheaper and more expedient to treat subgrades with oil before application of gravel.
2. Conservation of gravel is made possible.
3. Maintenance costs are reduced.
4. A more servicable road in all seasons is developed.
5. The dust hazard is practically eliminated, making traveling safer and more pleasant for the riding public.

U. S. Public Health Aid to Vermont

In *Engineering News-Record*, Dec. 1, 1927, p. 110, an error occurred due to the dropping out of one line of text. At the end of the third paragraph there reads, in parentheses, "This was furnished in the person of E. C. Sullivan, technical assistant in sanitary engineering." This phrase should have read: "This was furnished in the person of E. C. Sullivan, associate sanitary engineer and H. D. Cashmore, technical assistant in sanitary engineering."

A Riverman Discusses the Mississippi

Silt Burden Which Tends to Raise Alluvial Plain Is Best Disposed Of by Using Main Part of Basins as Desilting Reservoirs—Proposed Plan Would Provide Levees Around Land Areas Instead of Attempting to Confine the River—The Arkansas Problem—Diversions at New Orleans

By Ramey Williams
Memphis, Tenn.

For 40 Years Mr. Williams, who is a licensed master of river vessels, has had experience with Mississippi River floods. He is now employed by the Mississippi River Commission in a non-educational or a temporary civil service position. His article as printed herewith represents but a fraction of the manuscript submitted.

In his original article, which is one of the most entertaining as well as sane semi-technical writings on the Mississippi problem read by the editors for some time, Mr. Williams includes many a touch of the Mark Twain type. With a whimsicality not unlike that of Trader Horn he speaks of the river's unalterable opposition to adopting and maintaining "bi-channelism," whether from political motives or merely pure cussedness. The incompatibility of utilizing a silt-bearing stream as a drainage ditch and navigation canal is pointed out. There is discussed in detail the problem of silt, which causes "cross-overs" and willow-covered, velocity-curbing, silt-precipitating, section-contracting bars, which in turn produce more scour and fill below.

Facetiously he states that the most satisfactory method of control would be for the meteorologists to devise some means of regulating the "lows of marked intensity" that enter at the Gulf of California or at Vancouver Island and pass over the mainland as they list, the weather man carelessly allowing these troublemakers to wander across the continent and invite the warm moisture-laden winds from the oceans and gulfs to travel toward them and precipitate a lot of water no one has any use for. Of the construction of reservoirs on the headwaters he says that their only good feature would be the certainty with which blame for the floods could be placed on the operators of the reservoirs, "relieving Providence and the government of much of their present incubus of censure." He pays tribute to the levee engineers "They 'know their stuff,'" in his opinion, and make the best possible use of the material at hand.

In discussing the six basins of the delta, Mr. Williams mentions the earthquake which produced Reelfoot Lake long ago, and speaks of the "elderly gentleman with a goatee and a keen sense of humor"—Major T. H. Dabney—because of whose work the Yazoo district has not been flooded for a long time "because the Arkansas side always broke first," meaning that the Yazoo people had money from sufficient taxables to build their levees strong and high.

The vital feature of the article is its plan for extensive utilization of the basins as detention and disiliting reservoirs, as outlined below, in which he diverges radically from the official engineering recommendations now before Congress.—Editor.

THE underlying principle of the plan of control of the Mississippi River presented in this article lies in permitting the stream to do what it apparently desires to do—that is, to continue raising its alluvial plain and get its water during flood periods into the Gulf of Mexico by the most direct route.

The majority of streams have sufficient slope to carry downstream the material which headwater tributaries bring to the main stem of the river, but the Mississippi has not such a slope unless its length be much decreased. Therefore the real problem is to dispose of this detritus. The upper streams have a higher velocity, which will move greater amounts of solids. The lower river has less velocity and cannot carry so much material; therefore the material must stop somewhere. If it could all be shoved into the Gulf, it would not for a long time serve any useful purpose. But if this material, much of which is excellent food for vegetation, can be deposited over the lower part of the Mississippi basin or basins, it will be of immense benefit to future generations.

The best possible use that can be made of the basins composing the great alluvial plain from Cairo to the Gulf is to levee in the higher areas for agriculture and industry and permit the river to use the low-level parts of the basins for reservoirs, settling basins and outlets. This result can be effected by removing the levees from some portions where the river banks are naturally low and permitting the water to flow to the lowlands some distance away from the river banks.

For the St. Francis and Yazoo basins the natural outlets from the river should be near the upper end. For the territory protected it would be necessary to have levees on both sides instead of on only one side as at present. Whether the natural outlets into the St. Francis lowlands should be between Grey's Point and Cape Girardeau, a short distance below Point Pleasant, Mo., or elsewhere, or whether those for the Yazoo be near Lake Cormorant, Friar's Point, Sunflower Landing or at another point is a matter that can be determined only by giving it due consideration and investigation from an economic and engineering standpoint. It is true that all water, or at least much of it, that is let into these basins must return to the Mississippi River, but it would be water somewhat murky, as all ancient writers were accustomed to describe it, and not "soup," as modern writers call the present liquid.

As for the Reelfoot levee district, this should be abolished. At least the levees through No. 9 bottoms should be, and the water permitted to flow through Reelfoot Lake and the "Scatters." Then the river could fill up the lake or use it as a channel, whichever it desired. In either case there would be a large basin for the deposit of sand. These so-called abandoned areas, being in a humid region and having a rich soil, would be the best forest reserves within the United States. Such timber as we really need can be produced or reproduced there in a short time. And we as a nation are much more in need of forests than we are of farms.

The next in order would be the White River district. The upper part should be protected, whereas the lower part, including Laconia Circle, should be abandoned, since it overflows anyway whenever there is a flood. There would be no necessity of making any changes around the combination mouths of the White and Arkansas rivers, as this country is already a wilderness.

How to protect a part of the Tensas and adjacent basins is going to be a difficult task, for it involves the making of some disposition of the Arkansas River, which, by the way, is not a river at all, but merely the right-of-way for one. This right-of-way for a river through Arkansas has a discharge of only 1,000 to 1,200 sec.-ft. when it is at a low stage, but when the weather men get to manipulating their "lows of marked intensity" over its drainage area of some 160,000 sq. miles of red lands, it soon afterward furnishes some 700,000 or 800,000 sec.-ft. of water with which to flood southeast Arkansas and northeast Louisiana.

Since something must be done with the Arkansas River

water, possibly as good a plan as any would be to open up Boeuf River and let the water go down to the west of Sicily Island. This might make it possible to protect the upper part of the area drained by the Tensas River. Anyway, whatever is done, there will be a large tract of land made available for the growing of sweet gum, overcup acorns and other trees.

Some provision must be made to relieve the potential flood heights at and immediately below Vicksburg, caused by the discharge from the Yazoo basin entering the Mississippi. This would necessitate another outlet through the Tensas basin into the Atchafalaya. As to whether this outlet be wide and at some high point, or narrow at some low place, is for engineers to determine. The several basins, some small and some of considerable extent, that lie along the east side of the river between Vicksburg and Baton Rouge could be protected by levees or not, according to whether it would be possible to raise sufficient funds by taxation to pay for the project.

From Red River to the Gulf the slope of the Mississippi River is low and the amount of water great, hence it would be necessary to make an outlet basin of either that part of Louisiana that lies between the Atchafalaya and the Mississippi or all of the greater part of the low lands that are west of the Atchafalaya. In the Atchafalaya basin no attempt should be made to protect all of the lands by one or two levee systems, but instead there should be many independent systems, each having its own provisions for drainage. Here, as in other parts of the plain, the main consideration that should determine the location and extent of these protected areas is the effect it would have on the project as a whole. Since this is distinctly an engineering question, these leveed areas should not be permitted without authority having first been obtained from some federal engineer or board of engineers to whom authority had been delegated. Such a procedure might not be entirely in conformity with the matter of states' rights, but then the Adamson act, the conscript act (sometimes termed the selective draft), and the Eighteenth Amendment have about relegated states' rights to the discard anyway, so that a little more abrogation of these rights would not make any particular difference.

As for the New Orleans problem, it seems that the logical solution is for the federal government to aid that city in getting to tidewater by way of the Industrial Canal, Lake Pontchartrain, the Rigolets and Mississippi Sound, and then either provide a natural outlet or else construct a spillway below the city, so that there would be no possibility of the water ever again reaching the top of the present levee. If it were not for New Orleans and the near-by industrial district, which has much wealth and commerce from which taxes may be obtained, it would probably be better to open up Bayou Manchac and let the Mississippi River flow into Lake Maurepas.

My scheme may appear ruthless, and doubtless is, but so is the present levee scheme—which destroyed thousands of acres of good farm lands that were outside of the levees, completely annihilated the packet boat service on the river by making the territory between the levees and the river a wilderness, and through construction of ever higher levees has impoverished many of the communities that were supposed to be protected. It is claimed by the advocates of the exclusive levee system for flood control that the levee, if held intact, is an aid to low-water navigation. But in 1922 there was a prolonged flood; the levees of the St. Francis basin from Cairo, Ill., to Helena, Ark., held; yet following the flood there were more shoals and more hindrance and delay to navigation than had ever been experienced before.

Summary—The present levee system has caused sand bars and other lands between the river and levees to build up to considerable heights. It is evident that the natural or inherent characteristic of the river is to elevate as well as extend its plain. As long as this is so, any plan which does not provide for the disposition of the excess soil washed down from above is doomed to failure. My system not only will allow for the distribution of this rich soil over territory which will benefit directly from it, but will increase the natural wealth of the United States in lumber, encourage farming by the protection which the partial levee system will insure, and will, besides saving many lives and much property, be the source of a great financial saving both to the government and to those communities actually affected by the system. At present the Mississippi River is a liability to the federal government, but if permitted to build up and fertilize a part of the basin, while the other part is being utilized, it will in the course of time become a national asset.

THE RIVER TAKES POSSESSION OF THE LOW LANDS AT TIME OF FLOOD

Small Iron-Removal Plant for Red Bank Water-Works

Pumps at Distant Wells Deliver Water to Aerator and Pressure Filters—Chlorination Prevents Algae Growths

By Wellington Donaldson
Of Fuller & McClintock, Consulting Engineers
New York City

PURIFICATION works of 1.5 m.g.d. nominal capacity for eliminating the staining properties of the municipal ground water supply of Red Bank, N. J., were put in service recently. The processes employed are aeration and rapid sand filtration. The effluent is chlorinated for algae control. For reasons stated later, pressure instead of gravity filters are used.

Historical—The public water supply of Red Bank dates back to 1884, the initial installation comprising one or more 4-in. drilled wells, a pumping station, a lined earth embankment distributing reservoir of 1.5 m.g. capacity, and a distribution system. Additional 4-, 6- and 8-in. wells were installed up until 1897, ranging in depth from 250 to 700 ft. Water from the 700-ft. well was too highly impregnated with iron to be serviceable. Water from these old wells was pumped by direct

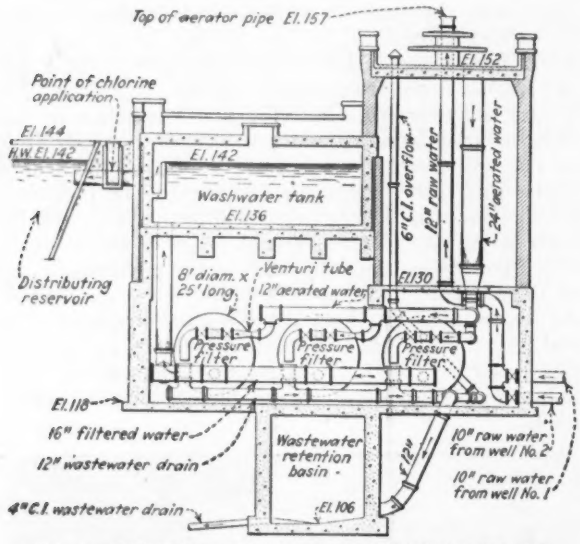


FIG. 1—SECTION THROUGH IRON-REMOVAL PLANT

suction or by air lift and then repumped to the distributing reservoir.

In 1925 there was put down at the old pump station a 15-in. well to a depth of 292 ft. and in 1926 a well of like diameter was sunk to a depth 287 ft. in another part of town. Both of these wells are equipped with motor driven multi-stage pumps which formerly delivered water directly to the distributing reservoir through independent discharge lines some 6,000 and 4,200 ft. in length respectively. Each well has a capacity of about 500 g.p.m., as measured by Venturi meters on each pump discharge. The static head pumped against is about 148 ft., including 27 ft. depth of ground water below surface.

The quality of the underground water has never been very satisfactory on account of its staining properties due to a considerable amount of dissolved iron. Aerators installed at the distributing reservoir in 1926 resulted in some improvement in the supply on account of partial deposition of the iron in the distributing reservoir; but complaints continued to be registered against the quality of water furnished. The writer was called upon to make investigation of local conditions in the latter part of 1926. An examination of the water from the two wells showed the following:

	Parts per Million	
	Well No. 1	Well No. 2
Free carbon dioxide (CO_2)	18.3*	17.0*
Alkalinity ($CaCO_3$)	109.0	109.0
Iron (Fe)	2.6	2.5
Manganese (Mn)	0.1	....

*Field tests with no loss in sampling.

It was further found that aeration and storage of about three days in the distributing reservoir reduced the free carbon dioxide to 7 and the iron to 1.6 p.p.m. Samples collected at random from the distribution system in different parts of the borough showed an average carbon dioxide content of 5.2 and iron content of 1.15 p.p.m.

Experiments were carried on by the writer at one of the well stations to determine the relative merits of coarse contact and sand filters for iron removal. Upward flow contact towers, 10 ft. deep, filled with 1- to 2-in. gravel, failed to remove iron below 1.1 p.p.m., while ½- to 1-in. gravel gave a residual of 1.0 p.p.m. in the effluent. Sand filters, operated at high rates, on the other hand, effected virtually complete removal (0.05 to 0.07 p.p.m.). Accordingly, recommendation was made for the installation of a rapid sand filter plant to remove the objectionable qualities of the supply. Work of constructing the new plant was started in August, 1926, and completed on March 31, 1927.

Fundamental Design Considerations—The general and special features of the purification plant are made plain by the accompanying illustrations. Both the location and the arrangement of the works were dictated by the layout of existing parts of the water-works representing considerable investment. The two wells forming the supply being located on opposite sides of town made necessary the placing of treatment works at the reservoir. On account of the segregated well pumps being started and stopped at a distance from the reservoir it was necessary to have the treament works operate as near automatically as possible without danger of the filters overflowing or running dry in the absence of an attendant. The latter requirement largely determined the use of pressure filters in preference to open gravity filters.

Open filters would have entailed installation of a wash-water tank of greater capacity than used, together with wash-water pump and power lines. The control of water levels in open filters would have necessitated constant attendance during the operating period, on account of sudden wide variations in water flow, or else complications in automatic control devices. Moreover, the construction cost of open filters would have exceeded the cost of the arrangements which were provided.

The writer believes that much unthinking prejudice exists against pressure filters as a part of present-day water purification practice. There is also too much readiness to assume that the latest developments are necessarily the best for all situations, regardless of local factors. After all, a filter, whether closed or open, is no better than its sand bed and washing facilities.

Details of Purification Works—As shown by Fig. 1, the raw water from one or both wells is pumped first

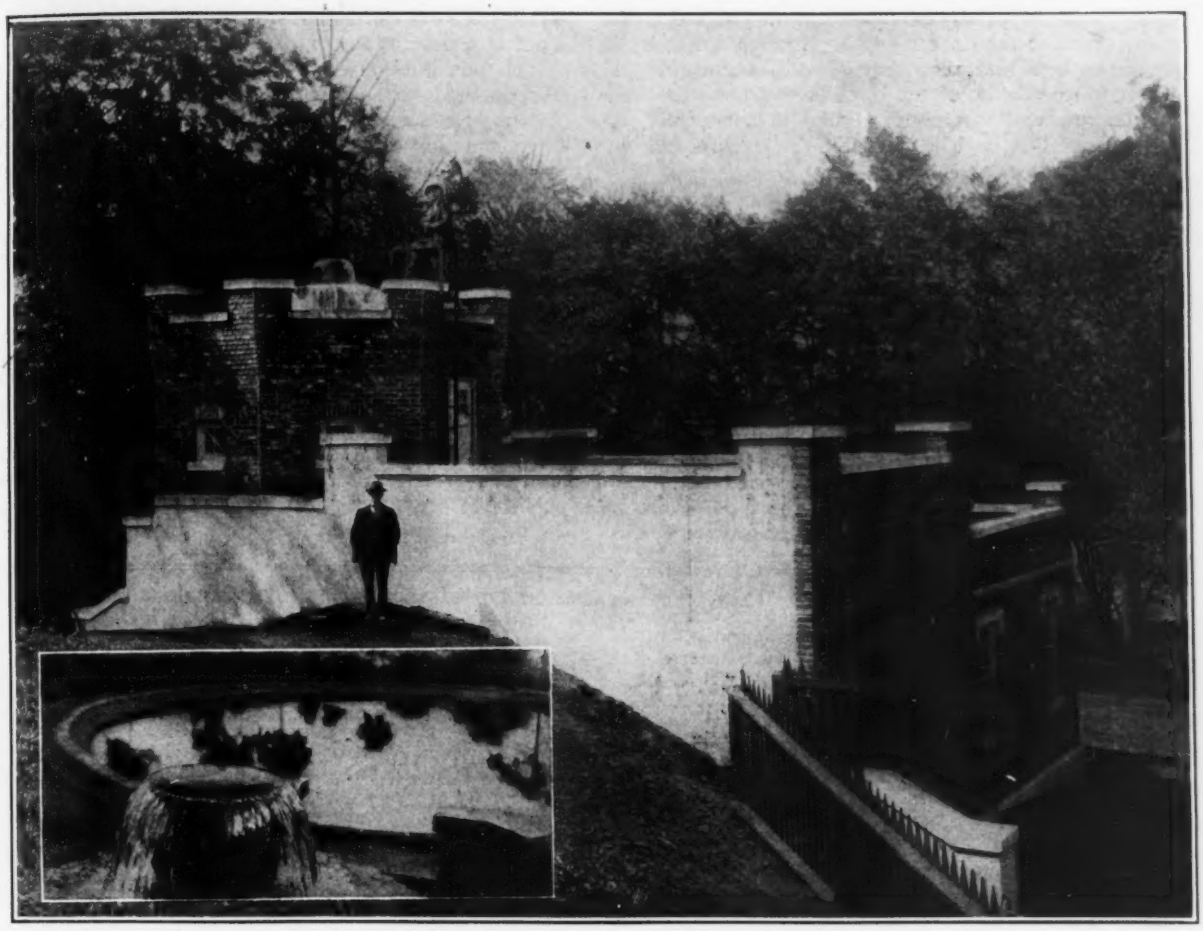


FIG. 2—IRON-REMOVAL PLANT FOR THE WATER SUPPLY OF RED BANK, N. J.
Large view taken from embankment of reservoir. Aerator at top of small tower. Insert shows aerator and corner of filter building with distributing reservoir beyond.

to a simple cascade type of aerator, from which it flows downward through three pressure filters, thence up to the wash-water tank, from which it spills over a weir into the distributing reservoir. The filters have no automatic controllers but there is ample area in two units to take care of the maximum flow. When a filter is washed, the discharge from the wells is automatically divided between the two units remaining in service.

The three filters are of the standard pressure type, 8 x 25-ft. horizontal units. They are equipped with perforated pipe underdrains, 16 in. of graded gravel and 27 in. of sand having an effective size of 0.43 mm. and uniformity coefficient of 1.48. The filters differ from the ordinary pressure filter in omission of the wash-water connection on the effluent side, this by reason of the fact that all filtered water passes through the wash-water tank of 13,700 gal. capacity on its way to the distributing reservoir. The filters are thus backwashed from the tank through the effluent connection and by the filtrate furnished by the two units in service while one is being washed. On account of this washing arrangement the Venturi tubes for measuring the flow of individual filter units were placed on the raw-water pipes instead of on the effluent pipes, as is customary.

Each filter has an indicating rate-of-flow gage. As all filter units are connected to common raw and effluent piping, a single loss-of-head gage serves to indicate the differential head across the sand beds.

The waste-water retention basin (Fig. 1) was necessitated by the small sewer available for carrying away the wash water. This basin, with a capacity of approximately 11,000 gal., allows the wash water to be wasted at a slow rate without overtaxing the existing sewer.

The building is heated by a steam furnace with automatic oil burner equipment.

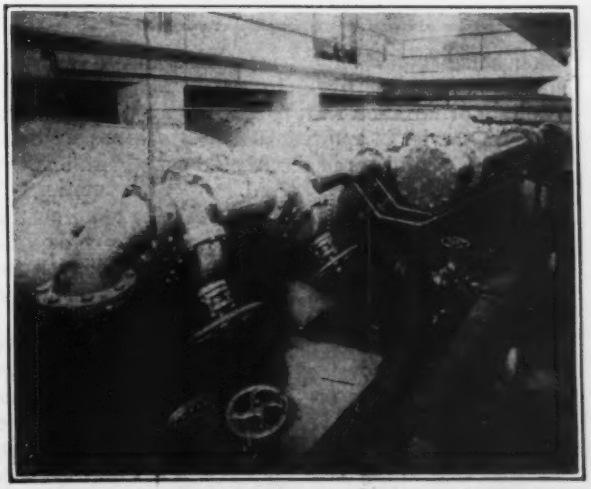


FIG. 3—RED BANK FILTERS AND PIPE CONNECTIONS

Chlorination—There is installed in the building a manually operated chlorinator feeding through a diffuser inserted in the effluent pipe leading to the reservoir (Fig. 1). Prior to installation of the iron-removal plant the water in the reservoir was always milky in appearance, due to oxidized iron, and little trouble was experienced with algae growths. After starting the iron-removal plant, however, the water in the reservoir became exceptionally clear and within five weeks time the reservoir became so clogged with filamentous algae (unidentified) that it was necessary to drain and clean. Since starting chlorination on July 1 no growths have appeared in the reservoir, though algae growths appear on the aerator tables, along with ochraceous iron deposits. The chlorine dose is about 4 lb. p.m.g. (0.48 p.p.m.) which gives a residual of 0.1 p.p.m. at the inlet side of the reservoir and none in the water going to town.

Operating Data—Since the plant was put into operation the average daily pumpage has ranged from 547,000 in April to 821,000 gal. in July. The three filters are washed daily, as a matter of convenience, the wash water being applied only about three minutes. The final loss of head in the filters before washing is 5 to 6 ft. The rate of filtration with both wells pumping and three filters in service is approximately 1.8 gal. per sq.ft. per min.; with two filters in service, 2.8 gal. With one well pumping these rates are halved.

Operation of the plant is very simple, requiring the attention of one man for less than an hour each day, for washing the battery of filters, adjusting chlorination and inspecting heating system which, as noted above, is automatic.

Analyses are not available to show the actual efficiency of the plant in removal of carbon dioxide and dissolved iron. Judging by the previous experimental results and the behavior of the old aerator, the carbon dioxide in the treated water should average about 7.0 p.p.m. and the dissolved iron 0.05 p.p.m. The objectionable effects of the iron have been entirely eliminated from the supply, and consumers are pleased with the improvement in quality.

The purification works were designed by Fuller & McClintock. The construction was supervised by the water-works superintendent, George McC. Taylor. The filters and filter equipment were installed by the Permutit Company. The completed cost of the iron-removal plant, including outside connections, wash water drain line and changes in pumping lines, was $52,881.

Use and Waste of Irrigation Water

LARGE loss of irrigation water in seepage from main canals and laterals is shown by figures recently compiled for the U. S. Bureau of Reclamation by E. B. Debler, hydraulic engineer in the Denver office. These figures, reproduced in the adjoining table from the (unpublished) original report, are derived from records of continuous measurements of water diverted and water delivered to farms. In case of projects having reservoirs within the distribution system, allowance was made for the probable losses in these reservoirs, so as to make the figures for losses and waste comparable with those of projects having no such reservoirs.

It appears from the figures in the last three columns that less than half the water taken from the supply stream is used on the land. One-sixth is wasted at canal wastegates and spillways, and about 40 per cent is lost in seepage through canal bottoms. The latter amount is seriously detrimental not only because it reduces the available irrigation supply, but also because it raises the groundwater level near the canals and thereby tends to make some of the land sterile through water-logging or necessitates the construction of costly drainage works. In one-third the projects listed in the table, the canal losses actually exceed the amount of water used to irrigate the land.

IRRIGATION WATER CONSUMPTION AND LOSS IN CANAL SEEPAGE AND WASTE ON FEDERAL RECLAMATION PROJECTS

Project	Irrigated Area, Acres	Area Commanded by Canals, 1926, Acres	Elevation Above Sea Level, Ft.	Length of Canals and Laterals Operated, Total, Miles	Length of Canals and Laterals Operated, Lined, Miles	Nature of Canal Materials	Nominal Delivery to Farms, A. F. per A.	Excess Actual Delivery Over Nominal(7) Per Cent	Delivery Plus Precip. During Growing Seasons A. F. per A.	—Per Cent of Total Division— Loss in Canals and Laterals (8)	Waste	Delivered to Farms (8)
Belle Fourche	45,164	74,569	2,800	547	58	Clay and sandy soil	1.11	6	1.97	38	15	47
Boise (1)	145,616	167,780	2,500	1,004	37	Volc. ash and sandy loam	3.60	4	3.98	24	..	..
Carlsbad	22,535	25,056	3,100	45	11	Sandy loam and gravel	2.36	4	3.22	48	6	46
Grand Valley (6)	10,139	30,350	4,700	180	..	Pervious—puddle lined	3.61	5	4.09	43	22	35
Huntley	19,406	32,540	3,000	232	..	..	1.26	5	1.89	39	30	31
King Hill (2)	6,441	16,888	2,750	96	..	Volc. ash and sandy soil	6.41	..	6.81	34	15	51
Klamath	43,325	64,983	4,100	240	2	Sandy loam	1.24	20	1.42	46	9	45
Lower Yellowstone	16,900	16,276	1,900	196	..	..	1.28	5	2.00	45	20	35
Milk River	16,793	73,252	2,200	275	..	River bottom	.65	10	1.56	36	19	45
Minidoka—South Side Pumping Div.	44,945	48,172	4,200	275	..	Sandy loam	2.54	..	3.07	39	3	58
Newlands	38,808	65,277	4,000	319	..	60% sandy, 40% clay	2.88	10	3.13	41	14	45
North Platte	107,694	253,094	4,100	1,154	..	Sandy loam	2.23	..	3.04	43	8	49
Okanogan (3)	6,210	7,300	1,000	75	39	Gravelly soil	2.55	..	2.83	25	..	75
Orland (4)	14,554	20,754	250	135	89	Clay and loam	3.17	..	3.55	27	9	64
Rio Grande	90,387	150,000	3,700	412	10	Silt	3.38	25	3.96	34	37	29
Shoshone Frannie Div. (5)	7,963	20,063	4,150	166	..	Sand and clay loam	2.19	10	2.58	42	21	37
Garland Div.	32,380	41,923	4,400	279	4	Gravel and loam	2.38	10	2.71	38	7	55
Sun River Ft. Shaw Div.	7,650	13,902	3,700	99	..	..	1.54	5	2.14	36	26	38
Greenfields Div.	9,867	41,975	3,700	190	..	Gravel-clay	1.28	5	1.93	31	22	47
Umatilla (6)	10,970	24,587	470	173	157	Sandy loam	5.02	10	5.37	32	18	50
Uncompahgre	61,178	95,202	5,500	470	11	½ adobe-shale, ½ S. & G.	5.76	5	6.31	13	10	77
Yakima Sunnyside Div.	91,726	102,464	800	602	125	Sand and volc. ash	3.29	5	3.50	23	7	70
Tieton Div.	27,607	32,000	1,500	335	86	Sandy loam and gravel	2.51	5	2.67	24	2	74
Yuma	51,950	64,865	120	336	..	Fine sandy loam	3.01	10	3.34	15	40+	..

(1) Boise data omit years of water shortage in 1919 and 1924.
(2) King Hill data cover years 1921–1925.
(3) Okanogan data omit years of water shortage 1918–1920, 1922, 1924 and 1926.
(4) Orland data omit years of water shortage 1918, 1920 and 1924. Slight shortages in other years included.
(5) Shoshone-Frannie Division data cover years 1922–1926.
(6) Umatilla, Grand Valley and Lower Yellowstone data cover years 1916–1925.
(7) The amounts charged to farms are shown in the preceding columns. Due to undermeasurement of deliveries the actual amounts are larger by the estimated percentages here shown. This has the effect of reducing the canal and lateral loss percentages.
(8) Based on nominal delivery. See note (7).

Chloro-Phenol Tastes Pervade Chicago Water Supply

Heavy Chlorination to Cope With Pollution From Indiana Towns Combines With Phenol to Produce Bad Tastes

Water-works operators whose supplies are drawn from lakes or streams receiving wastes from byproduct coke ovens have had added to their worries the constant fear of bad tastes and odors when these wastes reach the intakes and subsequently combine with chlorine used to eliminate bacteria in city sewage also reaching the intakes. Milwaukee had excessively bad tastes and odors from this source a few years ago. The following article tells of an experience at Chicago which far outdoes in volume of water, in population affected and apparently in the unbearableness of the tastes and odors anything heretofore experienced. The very high chlorine dosage of 13.6 lb. per million gallons seems to have dealt effectually with the sewage pollution, but, combined with 60 parts per billion of phenol, caused the trouble indicated. The water supplies of several Indiana towns were also affected by the bad tastes.—EDITOR.

WHILE Chicago's water supply is always subject to pollution by the sewage and industrial wastes discharged into Lake Michigan by the cities and manufacturing plants grouped at the south end of the lake, an unusually serious condition occurred recently, when the bad taste of the water led to widespread public complaint. This bad taste was due largely to the necessity of using a heavy dosage of chlorine to counteract the pollution, the chlorine combining with an exceptionally high phenol content in the polluted water. Thus the treatment which rendered the water safe was largely the cause of the complaint as to the taste or condition of the water.

The following particulars are taken in part from a report made by Dr. Bundesen, health commissioner for the Sanitary District of Chicago, but are supplemented by other information as to the water treatment and a later recurrence of the same trouble.

One of the worst periods of taste-producing pollution of water by industrial wastes at the southern end of Lake Michigan occurred Dec. 23-30, 1927, when the water supply of Chicago and of the Indiana cities of Gary, East Chicago, Whiting and Hammond, further south, was rendered undrinkable. This condition affected more than 3,000,000 people, as well as numerous industries using city water in the manufacture of edible products.

The taste-producing elements were phenol and cresol compounds of chlorine caused by the reaction of tarry acid wasted from by-product coke plants and combining chemically with the chlorine used for disinfecting the water supplies. The amount of phenol pollution was very great, being about 60 parts per billion, or from 4 to 10 times the quantity capable of producing the disagreeable "carbolic acid" or "iodoform" taste in drinking water.

Investigations indicate that these industrial wastes were discharged into Lake Michigan from the Indiana Harbor ship canal, apparently in intermittent batches between Dec. 22 and 28. There are coke producing plants on this canal, from which taste-producing wastes are discharged. Large quantities of oil wastes, mostly in the emulsified state, are discharged into the lake at Whiting. Taste-producing wastes from industries in Gary, East Chicago and Hammond are discharged into the Grand Calumet River, and these, together with the sewage from these cities, find their way into Lake Michigan through the ship canal.

The objectionable taste first appeared in the water supply at East Chicago and Gary on Dec. 23 and 24. According to the U. S. Weather Bureau records, from midnight Dec. 22 until the early morning of Dec. 24 the wind was chiefly from the north and northwest, the proper direction to cause drifting of surface waters from Indiana Harbor toward the Gary intakes. Bad tastes at Whiting, Hammond and Chicago followed a shift in the wind to the south and southeast, beginning about 2 a.m. Dec. 24. Hammond experienced its worst taste period on Dec. 28 and 29, following the south gale which commenced about 4 a.m. Dec. 28, and continued for fifteen hours.

At Chicago, the taste in the water supply appeared first at the 68th St. pumping station at about 2 p.m. on Dec. 28. By 9 p.m. the water from the three pumping stations (68th St., Roseland and Thompson) serving the south side developed a very intense taste. It is probable that this polluted water arrived at the 68th St. and Dunne intakes, which are nine miles from Indiana Harbor, about noon, or approximately seven hours after the southerly gale began. Based on float experiments conducted by the city's Division of Water Safety Control, this checks closely with the period of expected drift of surface waters from Indiana Harbor to these intakes. The height of the gale was a 48-mile wind at 10 a.m., Dec. 28. The approximate average wind velocity was over 30 m.p.h. for 17 hours, 5 a.m. to 10 p.m.

The phenol pollution arrived at the Four-Mile crib, 14½ miles from Indiana Harbor, about 10 a.m., Dec. 28, and caused a taste in the water in the loop and west side. By 7 p.m., taste developed at the Chicago Ave. pumping station, indicating that the pollution had arrived at the Two-Mile crib off Chicago Ave., 17½ miles from Indiana Harbor, about 6 p.m. During the late evening and early the next morning the characteristic chloro-phenol taste appeared in the water on the north side as far as Wilson Ave., 21 miles from Indiana Harbor. This would indicate that the pollution drifted as far north as the Wilson Ave. crib, but as the taste did not develop seriously in the extreme northwest side there is room to doubt this indication. Assuming that the pollution drifted only as far north as the Two-Mile crib, of which there is positive proof, the drift due to the gale was 17½ miles in 14 hours, or 1¼ miles per hour.

Simultaneously with the industrial pollution of the lake, there was contamination by sewage from a population of about 150,000 in the Calumet cities of northern Indiana, especially Whiting, Hammond, East Chicago and part of Gary. This sewage normally finds its way into Lake Michigan either directly through sewer outfalls (Whiting) or indirectly through the Grand Calumet River and the Indiana Harbor ship canal (Hammond, East Chicago and Gary). For several days prior to the emergency the Calumet River had discharged sluggishly into the lake and probably contributed in a small way to the pollution. The evidence does not indicate that there was serious phenol pollution from plants on the Calumet River.

It is reported that the public health emergency was met in Chicago by prompt and efficient chlorination control measures directed by the Division of Water Supply Safety Control. The operators at the pumping stations were warned of the probably dangerous condition and were prepared for the emergency. Had it not been for this warning and the precautionary measures taken a typhoid fever outbreak might have occurred.

The absorption of chlorine by the industrial wastes and sewage was exceptionally heavy and made it necessary to use relatively large quantities of this chemical to assure a safe water based on residual chlorine control. Indeed during the early or adjusting period of the emergency at all three of the south side stations tests showed from zero to only 1 lb. p.m.g. residual chlorine, whereas 2 to 2.5 lb. is considered necessary for safety. The maximum chlorine dosage of 13.6 lb. per million gallons was carried at the Thompson pumping station for one hour (9:35 to 10:35 p.m Dec. 28) when all chlorination stations were operating to full capacity. The average dosage during the 5- to 6-hr. emergency period was about 8 lb. per million gallons.

Bacterial analyses of special samples collected during the emergency indicate serious contamination by sewage organisms. The chlorinated water samples, however, show that the dangerous pollutional organisms were killed, so that the probability of typhoid fever epidemic was remote.

A survey of the conditions in the lake was made by tug on Dec. 29, the day following the bad-taste period. Two areas of phenol pollution of the lake were found; one north and northeast of the 68th St. crib and the other north

and outside of the Calumet light and breakwater. The northeast winds on that day prevented this second batch from entering the cribs and continuing the chloro-phenol tastes. However, on Jan. 7 and 8 the water on the south side and also in the loop district developed a second serious chloro-phenol taste, indicating that southwest winds had caused this pollution to drift to the cribs. During this second emergency it was necessary to use 10 lb. of chlorine per million gallons of water to carry a 2-lb. residual.

Failure of Non-State-Inspected Dam Under Construction

By H. T. Critchlow

Chief, Division of Waters, State Department of Conservation and Development, Trenton, N. J.

THE recent failure of a small dam under construction in New Jersey illustrates the need of state supervision of dams, even those impounding water from small collecting areas. Dams impounding water from an area of less than 1 sq. mile are now classed with those less than 5 ft. high in being exempted from state supervision under Chap. 243 of the Laws of New Jersey for 1912, now vested in the Department of Conservation and Development. (A pamphlet containing the statute, a form of application for a permit to build a dam, an outline of requirements as to specifications, location map and drawings, illustrated, may be obtained from the department, Trenton, N. J.)

The dam which is the subject of these notes failed during a severe storm of rain, lightning and wind on Nov. 17, 1927. It was located on a small branch of Peapack Brook, approximately three miles above the Borough of Gladstone, Somerset County. The drainage area above the site is 0.7 square mile.

The dam was to have been of the earth-fill and concrete core-wall type, with a maximum height above the stream bed of 32 ft. and a total length of 360 ft. There was to have been an overflow spillway on the right to take care of flood waters, but at the time of the failure this had not been completed. There was a 12-in. cast-iron blow-off pipe through the bottom of the dam in the bed of the stream.

The condition of the work just before failure was as follows: The concrete core wall was about 360 ft. long, 29 ft. high, 14 in. thick at the top, about 40 in. thick at the bottom, said to be founded on good clay. Earth had been piled against both sides of the wall to a height of 16 ft. The top width of the fill on each side of the wall was 8 ft. and the maximum bottom width was 32 ft. The 12-in. cast-iron blow-off pipe was said to be incased in concrete. This pipe was provided with a gate valve set in an open manhole in the downstream fill about 20 ft. from the core wall. The center portion of the downstream fill was the last to be placed and was evidently not carefully compacted.

The structure was inspected by engineers of the State Board of Conservation and Development on Nov. 21, about four days after the failure, but no evidence of a blow-out beneath the core wall was found. All the evidence points to failure due to the slumping of the center portion of the downstream fill. This probably took place as soon as the pond behind the dam filled up to the existing embankment, which it overtopped to a depth of 2 ft., bringing the water pressure to bear on the core wall. Simultaneous erosion from the heavy rain and the subsequent slumping of the newly placed downstream fill removed support from the center portion of the core wall. The core wall was overturned and badly shattered by the impact and subsequent rush of water.

No other damage was recorded except a washout of a small culvert on a private lane at the next farm below. It will be noted that the pond was only about half full of water at the time of the failure, otherwise the resulting damage might have been more serious.

This experience, combined with other cases where the drainage area is less than 1 square mile, emphasizes the desirability of having more complete supervision over the construction of dams than is now provided by the law. It is not the size of the drainage area which determines the danger to life and property in the valley below the dam. The more important things to be considered are the volume of water in storage, the height of the dam and the proximity of property and lives to the path of any flood which might be caused by the sudden failure of the dam. Some modification of the existing law is under consideration but the final change to be made has not been determined. It would be interesting to have some discussion on this point, namely, what are the limiting factors to govern the control of governmental agencies over the construction of dams to the end that the lives and property in the valley below be protected.

Australia Federal Road Plan Now Complete

New South Wales has finally joined the other states of the Commonwealth of Australia in the federal roads plan involving an expenditure of about $100,000,000 commonwealth funds over a period of ten years, says a report made public by the U. S. Department of Commerce. The approximate total expenditures, including that by the several states, will be: In New South Wales, $48,000,000; in Victoria, $31,500,000; in Queensland, $33,000,000; in South Australia, $20,000,000; in Western Australia, $33,500,000; in Tasmania, $8,750,000.

The Commonwealth's share of $10,000,000 annually is to be allotted among the states on the basis of three-fifths population and two-fifths area, the states spending 15 shillings for each pound contributed by the federal government. The amounts will be paid by installments into a trust fund, from which 3 per cent per year will be withdrawn for the purpose of a sinking fund. It is planned that a special tax on gasoline, and on automobile tires and chassis, will furnish the greater part of the money made available to the states of the Commonwealth.

The entrance of New South Wales into this road-building agreement revives the subject of state roads now under construction or in contemplation. The estimated cost of carrying out the complete work under consideration on the southern, northern and western highways of New South Wales totals over $85,000,000. Most of this work will be carried on by day labor, but several of the new roads will be done under contract.

Synthetic Atmospheres in Compressed-Air Work

In co-operation with the Navy Department, the Bureau of Mines during the past year carried on studies on the use of helium in diving and caisson operations, and in the treatment of caisson disease. Experiments with animal growth were conducted to determine the optimum decompression rate at various pressures. Final results are not yet at hand.

Road Builders Discuss Contracting and County Roads

Contracting Conditions Criticised—Drastic Remedies Urged—County Road Work Being Organized and Mechanized

OF THIRTY papers read in Cleveland last week at the technical meetings of the American Road Builders, a score related to contracting conditions and to county highway management. Both subjects are prominent, and the convention was turned pronouncedly to their consideration by strong and assertive sections of contractors and county engineers.

Contracting conditions and contractual procedure are in such shape in rural road building as to have aroused concern. Contracts are being defaulted, contractors are failing in business, other contractors are withdrawing from the field as being unprofitable and all contractors are complaining of low prices. The worst conditions are not universal, but they are prevalent. Making all allowances, and many must be made, the situation is bad. Contractors widely and highway engineers in considerable numbers believe it is bad largely because of vicious laws and practices—bad surety bonding, bad lien laws, bad sales and credit practices by equipment dealers, materials producers and many bankers. They are, therefore, striking at these laws and practices. A group of the abstracts given here indicate the lines of thought and action that are being pursued. These contemplate radical action and unusual organization functions. Abolition of liens, virtual boycotting of businesses, setting up mutual bonding organizations, virtual trade-association guaranty of individual obligations, are strong actions.

The second group of papers on county highway management are indicative of the radical turn which highway thinking has taken toward secondary road problems. Space has been given to only a few extracts; these emphasize particularly the engineering operations of county road work. In the full list of papers there were considered finance, legislation and administration, as well as construction and maintenance. Altogether they indicate a determination toward action that will keep to the counties their prerogatives in the administration and control of secondary roads. With the national organization of county road officials now well advanced, the movement commands attention.

Maintenance Equipment for Macadam and Gravel Roads

By W. W. Shields
Superintendent of Roads, Staunton, Va.

Macadam roads are still common enough in the older road building states to furnish a special maintenance problem. This article describes maintenance equipment and methods which have been developed in recent years for this old type road work. Compared with old practice, the outstanding feature is mechanization.

IN DITCHING, the use of a one-man power grader with an 8-ft. blade is economical. The grader is used to pull material from the ditches and sides of cuts to the shoulders and the excess material onto the edge of the macadam, where it is economically loaded by labor into trucks. The equipment needed is a grader and two trucks with 2- or 3-yd. dump body.

In patching the surface of a county system of oil treated and penetration macadam roads, the gang patrol system can be used with the greatest efficiency. This gang patrol consists of: A foreman in charge, six laborers and three truck drivers. The equipment needed is two 3-ton dump-body trucks for hauling stone and oil, one smaller truck for pulling maintenance heater and hauling men to and from job and one maintenance heater, of 160 gal., mounted on four-wheel chassis; this should have the fire box extending under the kettle proper, using wood or coal (fuel box on chassis), and have a short tongue for truck hitch. The gang patrol would work as follows: Three men filling depression in front from the rear of a large truck; one man firing and drawing oil; one man pouring oil and one man sweeping the loose rock back into the oil. Hand brooms should be used for cleaning the surface of the road.

The gang patrol and equipment should cover approximately 125 to 150 miles of 12-ft. road three or four times during a year, being off duty during the resurfacing season; it is economical to shift the gang patrol from patching to resurfacing and vice versa during the resurfacing season. One central garage and oil depot is used and roads within a radius of 15 miles are covered, using crushing plants within six miles of each other. Three crushing plants supply this gang patrol and 50 per cent of our stone is bought from local crushing plants, this being done on account of the short haul and the amount of stone needed.

The practice of having a central mixing plant is growing, and the extra equipment requirements are small—namely, a mixer suitable for mixing patching material with store bins.

The following equipment is used on our resurfacing work: Three crushing plants with proper grading revolving screen, one air compressor mounted on a small truck, four three-ton dump trucks and four smaller trucks, all used in spotting rock and keeping the crushing plants going. Rock loaders are necessary and economical. A 500-gallon oil distributor mounted on a 3½-ton truck chassis is used and resurfaces from 30 to 40 miles of 12-ft. road per season. One ten-ton roller to follow close on resurfacing work is positively necessary, and where more than one or two cars are applied continuously, two rollers are required to get satisfactory results.

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Power Equipment Reduces Upkeep of Rural Highways

By F. B. Wilkes
Superintendent of Roads, Maury County, Tennessee, Columbia, Tenn.

Experience is proving that power equipment is economical for maintenance of rural roads of the least costly traffic-bound types. The examples given here are indicative of practice under rather common rural county conditions. Change to motor equipment has lowered costs and improved service.

ONE hundred miles of the principal roads in Maury County, Tenn., designated by law as special highway, are maintained by a fund amounting to $150 per mile raised by a wheel tax on automobiles and trucks. We have discontinued the use of teams and are using motor patrol, having two one-man motor graders and a four-blade maintainer pulled by a light tractor. These machines can cover 10 to 20 miles and return daily, depending on conditions. With the maintainer we make a round trip pulling material to the center and then take the opposite side of the road and lightly push this material off, distributing it on shoulders; this gives a double working and lessens tendency to high crown. With

the one-man graders we pull material to center and make one round, pushing off, getting over each section once in about two weeks. We follow every two or three months with blade grader pulled behind a tractor to open ditches. About once each year we find it beneficial to scarify and re-shape with the heavy grader. Hauling is done with dump trucks at such times as these trucks are not in use on district roads. All loading is by hand. In addition to the above-named equipment we have three caterpillar tractors with graders, plows, scoops and air drills, etc., that are available for heavy work.

Reporting on Sussex County, Delaware, the county engineer says: The county has so large a mileage of rural road that it has been necessary to turn to machinery and an organization for year-around work. The machinery consists of 22 one-man tractor graders, one 10-ton tractor super grader outfit, one 6-ton tractor sixty grader outfit, one 5-ton tractor super special grader outfit and one 3-ton roller. With this machinery it has been possible to cut expenditures in half, and do about four times as much work. It was found that a one-man tractor grader outfit could do as much work for $7.50 as a team could for $32, the tractor being county-owned and the team being hired from first one farm, then another. Roads that were gone over with a scraper not over once a year are now gone over with the scraper from 15 to 20 times a year. The big grader outfits have been used to widen and drain narrow roads at a fraction of the cost of the old method of team and labor. By the use of big graders grubbing is eliminated, which is a big saving. Instead of plowing, all dirt roads are scarified, thereby making another saving. A grader type of scarifier is used. With the changeover from team to machinery it was necessary to have a central shop to keep the machinery in repair. The county has a very up-to-date repair shop, well equipped, lighted and heated. All supplies, tools and oils are bought at wholesale.

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Checking Plant Depreciation in Road Work

By W. R. Smith
President, Lane Construction Corporation, Meriden, Conn.

The mounting plant-depreciation charge in road construction costs is turning attention to methods of retarding loss of value by more scrupulous care. The task is made difficult by constant shifting of the plant as the work progresses, by the complete exposure and by the isolation. This paper describes the use of traveling repair trucks and visiting mechanics which and who go regularly from outfit to outfit in the field.

THE checking of depreciation by proper care of plant presents one of our most difficult problems. For years an attempt was made to house heavy equipment, but now all plant of size, except trucks and automobiles, is left in the open. We maintain repair shops at different points where winter repairs are made, but the volume of plant shipped in and out of these shops, except auto equipment, is comparatively limited.

We are continually trying new methods of plant supervision to prevent depreciation. Last year we purchased a truck operated by two men—one a gas engineer and the other a steam engineer. Tools for making repairs and some repair parts were loaded in this truck to its capacity. It then started on the round of different organizations, making repairs at the order of our master mechanic. In order to avoid friction with superintendents as to cost of repair, all expense of this truck was made a general repair charge and not a charge against the immediate job where the work was done.

This year we conceived the idea of a master mechanic, traveling steadily from one organization to another with authority to suggest repairs on plant as might seem in reason to him, the list of repairs being turned over to the superintendent in charge. If the superintendent in charge thought the repairs unreasonable, he could appeal to the decision of one of our division engineers who could arbitrate the matter. Our men are very jealous about the repair charges going against their cost. The mechanic's reports to the superintendent include mention of any abuse or improper use of plant which he may discover. Our master mechanic's car, carrying parts-catalogues of the greater portion of our equipment, covered something over 20,000 miles this last season.

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Palliatives for Vicious Practices in Road Contracting

By A. R. Hirst
Chief Engineer, Vibrolithic Corporation of America, Washington, D. C.

Five specific suggestions are made in this paper for action to improve conditions in highway contracting. They call for abolishing liens except the straight mechanic's lien, for reform in bonding contractors, for bonus-and-penalty provisions in contracts and for association action against every practice which establishes false credit. Both as possible remedies and as additional indictment of the agencies which endanger highway contracting they deserve attention.

MANY plans for improving contracting conditions have been suggested. All have the basic idea of eliminating unskilled and foolish bidders and thus, probably, insuring higher prices. None of them have developed the seed of success. Probably no single and simple plan ever will. The problem is too complex. Probably some things may be done to ameliorate conditions. Among them the following are suggested:

1. Concerted action by all concerned to eliminate all lien laws protecting sellers of machinery, materials and supplies.

There is every reason why government should protect the common and other labor on public work. These men have available no effective means of [illegible]ing the financial position of their employers, nor money to press their claims in case of default. This does not apply to the sellers of machinery, materials and supplies. These are intelligent men, fully able to take care of themselves, and with the means and ability to find out the facts about contractors.

2. Concerted action by all concerned to secure the inclusion in all specifications of provisions for severe penalties for delays and equally large bonuses for extra speed, and to insure their rigid enforcement.

Each highway structure—be it a road or a bridge—has a definite monetary value per day to the traffic. This value in saving to the traffic is readily computable. It is government's duty to serve its citizens by placing in the contract a penalty for failure to complete in the specified time, and likewise a bonus of equal amount for earlier completion. Provision for proper bonuses and penalties and their rigid enforcement on good, bad and indifferent contractors and their bonders, offers the most practicable system of rewarding those contractors who should be rewarded and of penalizing those contractors and bonding companies who should be penalized.

3. Concerted action by all contractors in the various contractors' organizations to select certain bonding companies and give them all their business provided those bonding companies (1) would not bond incompetents; (2) would show their books annually; and (3) would share the profits. If none of the present bonding companies would consent to do these things we would advise the organization of one which will.

Good suretyship should produce large profits on these preferred risks secured at small cost to the companies participating. These profits should be shared with the contractors co-operating in this proposed plan. This appeals to us as the only practicable plan of securing the so logical and desirable lower premiums on the high-class business. These bonding operations could, of course, be made to cover contract bonds on all kinds of building.

4. Concerted action by all concerned to eliminate bid bonds and certified checks not backed by the bidders' own cash.

There is much bidding without a proper backlog of cash resources. Bid bonds are still prevalent in many states and certified checks which have been worn out with use are frequently presented. The requirement that cash or its precise equivalent be put up at the time of letting would, in our opinion, eliminate many bidders with inadequate resources who are now bidding at many lettings with the idea that if they secure a job they can later finance it.

5. The boycotting by good contractors of all other factors in the game who are unduly encouraging unfair competition by the ignorant and incompetent.

There is no law prohibiting contractors' associations from publishing the low and other bids on a contract, with the names of the machinery, material, and supply men who furnish goods to the contractor. There is also no law preventing the individaul contractor from drawing his own conclusions and acting accordingly when this information is furnished him.

* * * *

Financial Worth Best Criterion of Contractor's Responsibility

By W. F. Creighton
President Foster & Creighton Co., General Contractors, Nashville, Tenn.

The volume of cash required in carrying out a paving contract of moderate size is often underestimated. Here the situation is emphasized by a specific example of operations coming well within the experience of the average contractor for concrete road work. Incidentally the article urges changes in contracting practice which are directly contrary to growing trends in highway engineering administration.

CASH is not the only requisite—skill and integrity are also essential—but since we should have a tangible rule, it may be concluded that if a contractor, under the highly competitive market of the past few years, has accumulated a cash surplus on his business and paid for certain equipment, it is evidence that he possesses the other requirements, and therefore for all practical purposes, financial worth is the main requisite for responsibility.

Cash Required—In order to determine the amount of cash required to carry a highway job, I recently analyzed a federal-aid concrete highway which our company finished last year. It was about seven miles in length and cost approximately $234,000. In considering the figures, bear in mind that this is in no sense a profit-and-loss statement, but is intended solely to arrive at the amount of cash invested in this job from month to month. To understand the figures further, I should explain that the contract provided for 90 per cent payments for the work done, but nothing allowed for material delivered, nor was the premium on the indemnity bond paid except as the work progressed. The equipment, which cost about $80,000, had been entirely paid for, and since it was not necessary to borrow any money, our actual interest charges were nil; also all material bills were discounted and only the actual amount spent included.

The work included grading, drainage, and a 20-ft. concrete pavement. Each monthly estimate was made up by the resident engineer, and the figures show that by no means were we paid 90 per cent of the work completed, but, as every highway contractor knows, this is customary. The main office overhead was charged as 2½ per cent, which it actually cost and I believe this is much lower than for the average company. The equipment rental was only charged on a basis of 6 per cent on $80,000 for 12 months. (Do not think that this is the proper charge; equipment repairs, depreciation, depletion, storage, interest, obsolescence, etc., on most pieces of highway equipment should be charged at least 25 per cent. One company has determined that from 1919 to 1924 inclusive, obsolescence alone amounted to 40 per cent of the plant investment, or 8 per cent per year.) The grading started in June, 1926, and as our state does not permit paving to be started until the fills have had sufficient time to settle, concrete paving was not started until the following spring. The work was completed in October, 1927, in 15 per cent less than contract time, and the final estimate was paid in December, 1927. Below is given month by month the amount of cash invested in this job:

	Cash Spent in Excess of Cash Received		Cash Spent in Excess of Cash Received
June, 1926	$3,505.68	April	$37,175.24
July	4,759.51	May	49,917.59
August	9,320.57	June	37,445.13
September	10,695.57	July	51,389.84
October	11,991.15	August	18,991.27
November	11,625.86	September	14,345.83
December	12,752.84	October	12,927.74
January, 1927	13,410.33	November	12,927.75
February	13,999.20	December	12,927.75
March	21,268.45		

In April, May, June and July, the average sum invested was $43,981.95, and the average amount invested over the entire life of the job was $19,358.39, or 8.2 per cent of the contract price. Also note that while the work was opened to traffic in October, it was December before the retained money was paid.

These figures show that it is absolutely essential for a contractor to have at least 10 per cent of his volume of business in quick assets and in addition a satisfactory line of bank credit, and still in addition, that his equipment be paid for.

Contractor Should Estimate Quantities—Another important means of increasing the contractor's responsibility is to lessen his dependency on the engineer for information. One way is to require him to prepare his own estimate of quantities. It is entirely too easy to ride over a project, study previous bids, secure a bid bond and dive in. The present method also encourages bidders from a distance to enter the competition, with sometimes a mistaken idea of local conditions. Let your work on a lump-sum basis. At first thought this may seem impracticable to engineers, who are accustomed to consider contractors dependent on them for quantities, but nowadays most contractors are engineers or employ competent engineers, and if the plans, profiles, cross-sections, and test borings are carefully prepared, I see no reason why contractors should not be able accurately to estimate the total cost of the work. The quantities in a road are not nearly as difficult to determine as those in a building, for which contractors now universally make their own estimates.

* * * *

False Credit Endangers Contracting for Road Work

By Allen J. Parrish
President, Illinois Association of Highway and Municipal Contractors, Chicago, Ill.

This article sets forth conclusions from a two years' survey made by an organization employing engineers, contractors and bankers to search and assemble the facts concerning credit practices in contracting. A remedy is proposed. The chief value of the article lies, however, in the statement of facts disclosed, which constitute a strong indictment of credit methods in the highway industries.

A CAREFUL survey of the highway industry, covering a period of two years, discloses an unhealthy condition. The leading cause is the growth of a system of false credit. Let us epitomize the facts found by investigation.

We have in business contractors whose oustanding bills and claims are far in excess of their total possessions. We have bankers who guarantee these contractors sufficient funds to answer the purpose of the standard questionnaire, and permit them to be awarded new jobs. We have bonding companies who furnish certified checks for bidding purposes to these contractors and who write bonds for them, taking notes for the premium, thus enabling them further to comply with the requirements of the standard questionnaire. We have machinery companies who are willing in their great greed to sell equipment, to take little or no down payment, and to take notes for future payment. We have contractors who purchase machinery under this most unsound practice and then mortgage it to secure finances upon which to

operate. We have material men who furnish these contractors materials and in some cases prepay the freight, and in return for this service accept payment at the completion of the job. We have material men who grant written releases and make affidavit that these contractors have met their obligations in order to aid them to obtain their final estimate.

The conclusions from an actual survey of the machinery industry and material companies are that the responsible contractor is paying 100 cents on the dollar for the products which he consumes, and that his competitor who utilizes this extension of false credit is paying 70 cents on the dollar for the same products. These facts have made it possible for as small a group as eight to ten per cent of the industry absolutely to set the price at which the responsible contractor must compete.

An agreement which we are putting into effect in the Illinois Association is that for all products shipped to the contractor in any one month he shall be granted a substantial cash discount for the payment of that account on or before the tenth of the next month. Said account when not discounted shall automatically become due on the first of the following month, and if payment is not made, shipment shall be stopped by this producer. No other producer shall ship to this contractor without first satisfying the account of the first shipper.

We are satisfied from the reaction which has been obtained from all the industries consulted that the plan is feasible, and that while it will cut down the rapid growth of some concerns and may tend to curtail the activities of a great many, it is the logical way of stabilizing the industry and of placing contracting on the roll of legitimate and sound businesses.

* * * *

Some Economic Considerations in Using Snow Fence

By V. R. Burton
Engineer, Research and Statistics, Michigan Highway Department, Lansing, Mich.

Recognition of the portable type snow fence as an operating plant unit, which involves all the charges (first cost, maintenance cost and operating cost) of any other equipment for combating road obstruction by snow, is not common. This paper brings the fact clearly before highway maintenance men. It shows that the expenses of portable snow fence when capitalized often warrants purchase of increased right-of-way and building a permanent drift barrier or the adoption of other construction measures.

BY ADEQUATE drift prevention is meant sufficient protection to enable the plows to handle the work easily and to permit the use of light instead of heavy equipment on patrol. A few hundred feet of snow fence placed at strategic points many times saves the use of a heavy outfit at points miles from headquarters. There is the danger, however, that some road officials will think that portable snow fence in large quantities may considerably increase their costs by its indiscriminate and universal use. This is not the case.

Assuming a five-year life for fence, a foot of movable picket snow fence costs about 6c. annually for depreciation and interest, erection and dismantling. This makes an annual cost per mile of fence of $316.80 for one side of the road only. If we assume a ten-year life of fence, the annual cost per foot is 5c. and the cost per mile $264. It is safe to say that the annual cost is somewhere between the two, probably at about $300. This means that, with only a 5 per cent coverage on one side of the road, a $15 per mile cost must be charged to portable snow fence. If the annual cost of snow removal is only $30, it is certain that $15 per mile is an excessive amount to spend for fence. If the annual cost is over $200 per mile, it is probably not enough. As a tentative figure the Michigan State Highway Department has set 25 per cent as a fair average figure for that proportion of the snow removal cost which should be spent on snow fence or other drift prevention measures. This figure will vary mile by mile naturally, and probably in some of the heavier snow territory will have to be exceeded to give satisfactory service. On the other hand, in some of the less difficult districts, it will be omitted altogether. This means that from this winter on, very little more portable snow fence will be used in Michigan.

It should be stated that the situation with regard to snow fence is entirely different if the erection and dismantling cost is not incurred annually. This amounts to about 4c. a foot and is the reason for the limitations on the use of the portable type. If we capitalize the saving of this cost amounting to $211.20 per mile at 4½ per cent, we find that we can afford to pay for right-of-way on but one side $4,969.41, or nearly $5,000 a mile, and erect a permanent snow fence.

There are about 5 acres of land involved in widening a half-width of right-of-way from 33 ft. to 75 ft., and this would give ample width in most cases for permanent snow fence on the right-of-way line. We could then afford to pay $1,000 per acre for right-of-way on which the fence could be erected permanently. Even if we only desired a 10 per cent coverage, we could afford to pay $50 per acre for right-of-way throughout the entire mile widened from 66 to 150 ft.

* * * *

Require Separate Sizes of Stone for Road Concrete

By R. T. Giles
Chief Engineer Concrete Control, Blaw-Knox Co., Pittsburgh, Pa.

Segregation of coarse aggregate is a real obstacle to concrete control in road work. With the best possible set up to control cement, sand and water and with the closest regulation of stone sizes at the quarry, stone segregation in field handling and stock-piling often upsets the whole process of close concrete control. This article proposes that coarse aggregate should be shipped by the producer in two or three sizes which may be combined on the work as conditions may require.

THE separation of coarse aggregate into several sizes for the manufacture of concrete is of extreme importance and is attracting more and more attention. The need for this refinement in the manufacture of concrete is not, as some seem to believe, due to the fact that the quarries do not produce and ship the proper sizes to give the desired grading but is due to segregation in handling the material after it leaves the quarry and before it enters the mixer.

Various methods have been tried to prevent segregation in the field. California requires the coarse aggregate to be shipped in two sizes and definite amounts of each size measured before entering the mixer. Iowa has reduced the maximum size and requires that stock piles be built in layers and limits the height of the stock pile. The most satisfactory specification is that used in North Carolina for some special experimental pavements that are now under construction.

In spite of the fact that a 1:2:4 mix was regularly used for concrete, it was felt that by using inundation to control the fine aggregate and by separating the coarse aggregate into three sizes and measuring each size, the mix could be increased to 1:2:4.65 and a concrete of suitable workability secured. This has proved to be the case. The idea in resorting to such a specification is primarily economic, and unless a concrete equal in value to the concrete obtained under the 1:2:4 mix is obtained, there will be no economic advantage. Had the maximum size of the coarse aggregate in these special specifications been increased to 2½ in. or 3 in. at the same time that the mix was changed from 1:2:4 to 1:2:4.65, it is possible that even a better quality concrete might have been secured than was obtained by the old mix.

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

Regulation of the Great Lakes

REVIEWED BY IVAN E. HOUK

Research Engineer, Bureau of Reclamation, Denver, Colorado

REGULATION OF THE GREAT LAKES AND EFFECT OF DIVERSIONS BY CHICAGO SANITARY DISTRICT—By John R. Freeman. Part of the Report of the Engineering Board of Review of the Sanitary District of Chicago on the Lake Lowering Controversy and a Program of Remedial Measures. Chicago: The Sanitary District of Chicago. Cloth; 6x9 in.; pp. 548; tables, maps and diagrams.

Most hydraulic and hydrologic engineers of the country will be interested in Mr. Freeman's comprehensive study of the Regulation of the Great Lakes. All who go into the subject will appreciate his thorough investigation of the hydrographic conditions which have brought about the necessity for regulation of lake levels and discharge, as well as his careful development of plans for adequate regulating works. The fact that the subject matter overlaps to some extent the material in the Report of the Hydrology of the Great Lakes, by R. E. Horton in collaboration with C. E. Grunsky (reviewed by Prof. H. K. Barrows in these columns on Dec. 15, 1927, p. 967), is desirable, rather than objectionable, in the case of a great project like the one under consideration.

Lake levels are now approximately 3 ft. lower than six or eight years ago, but not lower than on certain occasions in the past, particularly a hundred years ago. About 5 in. of the recent lowering has been caused by diversions through the Chicago Drainage Canal, while the remainder has been caused primarily by a series of years of low rainfall which can be expected to terminate some time in the near future. Each foot of lowering has meant an increased cost of freighting amounting to about $6,000,000 a year—a figure which can also be used in estimating the value of raising the lake levels by regulating works.

Mr. Freeman's studies show that it is possible to raise the lake surfaces from 3 to 4 ft. over the recent low levels by the construction of regulating works on the Niagara and St. Clair rivers, at an approximate cost of $8,000,000 and $25,000,000. Such works can be built within a period of five years. They will permit the regulation of the lake outflow so that the minimum mean monthly discharge of the Niagara and St. Lawrence rivers can be decreased about 20,000 sec-ft., giving a possible additional 910,000 hp. of electrical energy.

Regulation of lake levels with a variation of less than a foot between summer and winter stages is not considered possible. The normal high-water elevation adopted in the plans is a foot below the record high water of 1838, this elevation being chosen to provide a margin of safety for the great storms which may be expected to occur once or twice in a century. No plans for control works at the outlets of Lakes Superior and Ontario are considered, inasmuch as Lake Superior is already provided with regulating gates, while regulation works for Lake Ontario are being studied by an international commission.

The type of design adopted for the regulating works consists of a series of arched concrete sluiceways of about 72-ft. span, controlled by adjustable drop-weir gates of structural steel plates and girders, hinged at the base. The works designed for the regulation of Lake Erie are located near the falls and are surmounted by a broad concrete highway bridge. These structures were planned with the preservation of Niagara Falls as one consideration. The works proposed for the St. Clair River comprise a 3,200-ft. open fairway, shaped like a venturi flume, at the center of the river; a series of 12 sluiceways on each side of the fairway, each sluiceway structure being 984 ft. long; a 1,350-ft. lock along the outer end of each sluiceway structure; and a contemplated future lock on each side of the stream channel. The locks to be built first are designed for a clear depth of 25 ft., those to be built later are planned for a clear depth of 30 ft., and the open fairway is planned for a clear depth of 27 ft. A rather novel feature incorporated in the design of the fairway is that the bottom is covered with baffles, arranged so as to cause a flow of water along the bottom of the channel from the center toward the sides, up the sides, and from the sides along the surface of the stream back to the center of the fairway, thus producing a spiral motion which will automatically tend to keep the vessels, as well as floating ice, away from the side walls.

The regulating structures are adapted to future deepening of the navigation channels by dredging, should such operations later be found advisable. It is recommended that the lake levels be raised above the proposed normal low-water plane at the earliest practicable date, but that the definite establishment of normal high and low levels be postponed until a final adjustment can be made between the cost of dredging and damage by flowage, inasmuch as complete regulation of discharge will not be needed for some time. Unified international control of regulation works is recommended for all of the Great Lakes. The construction of compensation works, such as have been proposed for counteracting the lowering of lake levels caused by the Chicago Drainage Canal, is disapproved. Such works would consist of a series of submerged weirs and would cause an increase in upstream stages because of the restricted channel cross-section.

Mr. Freeman's report discusses in more or less detail all of the various conditions affecting the design of the regulating works, including past variations in lake levels, diversions, meteorology and hydrology of the lakes and tributary drainage areas, earth tilt, discharge of outlet channels, effect of ice jams, variations in Chezy coefficients, backwater conditions, possible range of regulation, requirements for navigation, drainage, and power, cooperation in cost distribution, previous reports on related lake problems. Many of the data are presented in the form of tables, maps, and diagrams, especially those relating to the meteorology and hydrography of the Great Lakes region and those pertaining to the hydraulics of the outlet channels. In connection with the studies of lake discharge it is interesting to quote the conclusion "that the gagings of discharge of Lake Erie through the Niagara River, made under the supervision of the U. S. Army Engineers by Assistant Engineers E. E. Haskell, F. C. Shenehon, and L. C. Sabin, are doubtless the most accurate and precise gagings of a great river that have been made anywhere in the world."

Approximately 150 pp. of the report are devoted to studies of lake evaporation, of which 60 pp. are included in Appendix 2. Additional Notes Upon Data for Estimating Evaporation from the Great Lakes. The estimates of water losses through evaporation were calculated by five different methods: (1) On the basis of inflow minus outflow; (2) by Professor Russell's formula proposed in 1888, based on observations of wet- and dry-bulb temperatures and measurements with the Piche evaporimeter; (3) by monthly mean air temperatures and evaporation measurements at Boston, Rochester, University of South Dakota, Grand River Lock, Wis., and Keewatin, Lake of the Woods; (4) monthly mean water temperatures and measured evaporation at the above noted stations; and (5) by the Dalton theory, using the formula $E = (V - v)\ (0.5 + 0.05W)$, where E is the depth of evaporation in inches per 24 hours, V, the saturated vapor pressure corresponding to the temperature of the water surface, v, the vapor pressure corresponding to the dew-point temperature of the air, and W, the velocity of the wind in miles per hour.

As might be expected, the first and fifth methods were the only two found to be entitled to confidence. Accuracy of results by the first method are dependent primarily on the accuracy of the rainfall, tributary runoff, and lake discharge measurements, some uncertainty being involved in the last, in the case of the Great Lakes, due to the effect of ice obstructions. The accuracy of results by the fifth method is dependent primarily on the applicability of the available measurements of water-surface temperature, dew-point temperature of the air, and wind velocity, to the lake areas as a whole; also on the accuracy with which the wind factor has been determined. The diagrams of results obtained by the two entirely different methods show a remarkable agreement and inspire confidence in the conclusions reached by Mr. Freeman.

One of the most interesting things brought out by the evaporation studies is that the rate of evaporation for the Great Lakes is greatest in the fall or winter and smallest in the late spring and early summer. Lake Superior, especially, seems to experience practically no evaporation during May and June, and an unusually high rate during the winter, the maximum monthly rate amounting to approximately 3.5 in. in January. Undoubtedly the explanation of this curious condition lies in the great volume and depth of water with the resulting relatively low water temperatures during the summer and relatively high water temperatures during the winter, the greater proportion of the lake area remaining open all winter in spite of long periods of sub-zero air temperatures. The curves for the different lakes seem to indicate this explanation, the conditions being most unusual in the case of Lake Superior and least unusual in the case of Lakes Erie and Ontario.

The conclusion reached as regards total lake evaporation is that "the evaporation certainly averages more than 2 ft. per year, and certainly less than 3 ft.; and is probably about 22 in. on Superior, 27.5 in. on Michigan-Huron, 36 in. on Erie, and 33 in. on Ontario; and about 27 in., or say 2¼ ft., for the five Great Lakes as a whole." It is pointed out that despite the vast extent and importance of the Great Lakes no accurate direct measurements of evaporation have ever been made within or near the margins of the lakes, either in the United States or Canada, a condition which is rather surprising considering the large number of evaporation stations which have been maintained in different sections of the country during the last twenty years.

Appendix 2 contains brief notes regarding many important evaporation studies which have been made in the past, or are now being conducted, in different parts of the country. However, no reference is made to the excellent and comprehensive investigations being carried on by the Bureau of Roads, U. S. Department of Agriculture, at Fort Collins, Colo., under the supervision of Irrigation Engineer Ralph L. Parshall. It is interesting to note that Mr. Parshall found the Dalton theory to apply to his experiments, and that his formula, $E = (E_s - E_d)(0.44 + 0.118W)$, is almost the same as Mr. Freeman's, the quantity $(E_s - E_d)$ being the same as Mr. Freeman's $(V - v)$. Mr. Parshall's formula is given in his discussion of the reviewer's article on Evaporation on United States Reclamation Projects (*Proc.* Am. Soc. C. E., January, 1926, and *Trans.*, do., for June, 1927, Vol. 90, p. 266).

Many interesting meteorological and hydrological conditions are discussed in connection with the evaporation studies. These include air temperatures, water temperatures at the surface and at different depths, rainfall, humidity, wind velocity, relation of wind velocities on the lakes to those measured at Weather Bureau stations, relations of tank to reservoir evaporation, effect of vapor blanket on evaporation, extent and frequency of fogs, seiches, proportions of ice cover, formation of ice crystals, water currents, effect of change in forest condition on rainfall and runoff, and other data. Regarding deforestation the conclusion is that deforestation has had no noteworthy effect on lake levels or on water yield of the higher Great Lakes drainage regions as a whole.

Earth tilt, about which some authorities have disagreed, is taken up in detail, the investigations of Dr. G. K. Gilbert, Frank B. Taylor, Sherman Moore and others being adequately discussed as well as the studies of the author. Interesting and convincing diagrams are included showing that the surface of the earth in the region of the Great Lakes has been tilting upward to the north and east during the past fifty years at a rate of from ½ to 1 ft. per 100 miles per century. The hinge line is believed to be located a little south of Cleveland and Chicago and the axis of maximum tilt is found to bear about 18½ degrees north of west. This condition is believed to be increasing the depths in the Chicago and Cleveland harbors at a rate of more than a foot in 100 years.

Mr. Freeman's report contains a vast amount of interesting engineering data on the Great Lakes problem as well as comprehensive plans for regulation of lake levels and discharge. Engineers interested in the lake situation, or in related problems involving analyses of meteorological and hydrological conditions, will find it a valuable reference book.

Aviation's Rolling Stock

MODERN AIRCRAFT: Basic Principles, Construction, Operation, Repair, Application, Maintenance. A Simplified Text Suitable for School or Home Study. By Major Victor W. Pagé, Air Corps Reserve, U.S.A., M. Am. Soc. Automotive E., etc. New York: Norman W. Henley Publishing Co. Cloth; 7 x 10 in.; pp. 855; 400 illustrations. $5 net.

Major Pagé's book considers the airplane and airship *per se*, is written for the average student, and should be well adapted for instruction work on general principles of mechanical flight. What is just as important from the civil engineer's viewpoint is that the book is interesting enough to be read, and, therefore, useful. Both curiosity

and necessity have caused the civil engineer to study the general principles of design and operation of railroad rolling stock. This book, considering, as it does, such subjects as design and construction of aerofoils, wings, fuselage, landing gear, and water cooled and air cooled engines, principles of airplane equilibrium and control, and methods of inspection and maintenance, should help satisfy the same need in regard to aircraft.

The New City Profession

THE CITY MANAGER—By Leonard D. White, Ph.D., Professor of Political Science, University of Chicago. Chicago, Ill.: University of Chicago Press. Cloth; 6x9 in.; pp. 355; charts, maps, several portraits of city managers. $3.

The author's mode of approach in his admirable examination of the new profession of managing cities is to take up a goodly number of managers, generally those who have been notably successful. First he gives a chapter each to Hopkins of Cleveland, Sherrill of Cincinnati, McElroy of Kansas City, and Koiner of Pasadena, the work of each and their relations with their city councils and communities. Then the successive managers at Dayton, beginning with Waite, are reviewed. Eight other men are then considered. The author then takes up the city manager—in general, in city charters, in relation to the council, to the whole range of municipal administration and as a "professional executive."

Of the dozen managers reviewed in the opening chapters, eight are engineers. Of 863 managers covered in an appendix entitled Prior Occupation of Managers, 393 or nearly half appear under the head, Engineering and Allied Activities. The next highest group, Business or Executive Classes, includes only 103. Next to this stands City Employees and Department Heads, with 67. Somewhat unfortunately, but not at all surprising, the prior occupation of 154 of the 863 managers is "unknown." These figures, together with much that the author presents in his text, show both the important part that the engineer plays among city managers and the fact that if there is a well recognized standard for managers the councils that make the appointments do not follow it, although the tendency is to accept the engineer as coming nearest to meeting the demand.

While complimentary to engineers, the author is inclined to blame them, with some apologies, for being more interested in the engineering than in the other city departments. He makes a general charge against all the managers, regardless of previous occupation, that they have contributed little to the art of governmental administration, although as a class they have been devoted to their work and have been good managers. He is particularly concerned because none of the managers seem to be members of one or two organizations devoted especially to administration and personnel and few of them appear even to know that there are such organizations. This may be regrettable yet forgivable.

The author also seems to think that the managers do not assume a sufficiently full leadership in municipal affairs. At the same time he realizes that attempts to lead are beset with dangers and run counter to the theory of council-manager plan, under which the council determines and the manager carries out policies. He states that the newer managers are more inclined than the older ones to assume leadership, not because they are more progressive but through inexperience.

A strong point in favor of the book is that it is written by one who has specialized in administration. Valuable features besides those mentioned are tables of manager cities by states, and a list of erroneously reported manager cities, excluded from the tables in this book. One of the tables, supplied by the International City Managers' Association, gives for each manager city its 1920 population, date the plan went into effect, number of managers (Phoenix, Ariz., has had 7 since April, 1914!), name of the manager, number of cities he has served, date of latest appointment and salary. The total number of cities listed as under the council-manager plan is 364, including 16 in Canada and two in New Zealand.

Many of the author's facts and deductions are based on local contacts during some months of study in manager cities. The book is not only the latest but on the whole it is also the best presentation of the council-manager plan, with attention centered on the manager. In view of the large percentage of managers who are engineers and the scores of engineers who apply for many of the vacancies, the book should appeal strongly to the members of the engineering profession.

Additions to Wegmann's Dams

THE DESIGN AND CONSTRUCTION OF DAMS: Including Masonry, Earth, Rock-Fill, Timber and Steel Structures, Also the Principal Types of Movable Dams—By Edward Wegmann, C.E., M.Am.Soc.C.E., Consulting Engineer, New York, Author of "The Water Supply of the City of New York, 1658-1895," "The Conveyance and Distribution of Water for Water Supply." With a Mathematical Discussion and Description of Multiple Arch Dams—By Fred A. Noetzli, D.Sc., M.Am.Soc.C.E., Consulting Engineer, Los Angeles, Calif. Eighth Edition, Revised and Enlarged. New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd. Cloth; 10x12 in.; pp. 740; 273 halftone and line cuts in text, 50 inset halftone and line cut plates, 91 large plates of drawings of designs of dams; bibliography, index. $17.50.

A notable addition to the new edition of Wegmann's well-known work on dams is a section of nearly a hundred pages on multiple-arch dams by Fred A. Noetzli. Mr. Noetzli takes up in succession the arches and the buttresses of large arch dams, then describes in one chapter a number of American and in another a number of foreign dams of this type. This part of the book has a chapter on "New Types of Buttress Dams" and a chapter on the "Arch Dam Investigation of the Engineering Foundation," relating to the experimental single-arch masonry dam on Stevenson Creek, in California.

Besides this entirely new section, Mr. Wegmann has inserted at various points in his text a description of a number of dams not included in earlier editions. Some of these are so recent as to be at the time of revision little beyond the design stages.

The book still suffers, as has been increasingly the case with successive editions, through having some of its new matter inserted out of its natural place and also through retaining phraseology, such as the word "recent," that will mislead the uninformed and irritate the informed. Thus, "recent" occurs in the opening words of the chapters on both hydraulic-fill and rock-fill dams. It is particularly shocking, for those who know better, to read that "A novel method of building dams of earth and gravel has been used in some of the Western states." This statement was quite true when the chapter on the hydraulic-fill process was added to the original book, but it is unfortunate language to use in 1927, especially in view of the advanced methods in hydraulic-fill dam construction used some years ago by the Miami Conservancy District and still further East and quite recently on the Davis Bridge dam in Vermont—which, we regret to find, are not given even a footnote mention.

All the oversights noted in the second paragraph of our review of the seventh edition (*Engineering News-*

Record, August 17, 1922, p. 284) continue to stare the well-informed reader of the book in the face and are likely to mislead the uninformed. This is particularly true of the table of high masonry dams, which does not include the Arrowrock dam, although it is described in the text. A very recent addition to high earth dams, the Calaveras, is inserted in the table on such dams, but instead of topping the list, as arranged by height, it is placed at the bottom, where it will be overlooked by many.

These shortcomings of revision are mentioned with regret in view of the difficulties and expense confronting authors and publisher whenever a technical book originating nearly three decades ago is up for revision, but it is one of the functions of a reviewer to point out how a new edition differs from an old one, especially when size and cost make necessary so high a price as is put on this volume. Comparatively small effort and expense would have removed some of the anachronisms in this book and have brought it more nearly to date as to omitted dams and dam failures of great significance. Obsolete or relatively minor matter could have been stricken out to more than offset much-needed new material.

Mr. Wegmann has stayed by his book so long and faithfully that it is hoped he will yet undertake a thorough-going revision, with well chosen collaborators if need be, putting all the new material in its proper place, substituting actual dates or other appropriate phraseology for language correct twenty years ago, making sure that the additions to the dams described, either as built or having failed, are thoroughly representative, revising the two tables for high masonry and high earth dams and bringing the bibliography to date—no additions in the eighth edition. In such a revision "construction" should either be omitted from the title or else be far more comprehensively treated than now, with due regard for the great advance in construction methods during the past decade. Whether such a revision should be accompanied by throwing out a large percentage of the descriptions of individual dams, many of the large scale analytical cross sections and some of the handsome half tone views, thus reducing the size and cost of the book, even with new material added, is a question on both sides of which much could be said. Certain it is that $17.50 is a price for a single book on one branch of engineering beyond the pocket books of many engineers, especially the younger ones, who presumably are most in need of just the right kind of books in various fields of engineering literature.

Our Federal Health Administration

FEDERAL HEALTH ADMINISTRATION IN THE UNITED STATES—By Robert D. Leigh, A. Barton Hepburn Professor of Government, Williams College. [Harper's Public Health Series, Edited by Dr. Allan J. McLaughlin.] New York and London: Harper Brothers, publishers. Cloth; 6x9 in.; pp. 687. $5.

Never before has federal health administration in this country been dealt with so comprehensively and at the same time by a writer versed in the theory and practice of governmental administration. As a result, we have not only a large and detailed picture of what is done by the government in the way of direct medical care of the sick in the army and navy, of the Indians and other wards of the nation, but also a review of federal public health activities, the whole presented historically and with searching criticism, from both the health and administrative viewpoints. At appropriate points throughout, and elaborated at the close, detailed consideration is given to the problem of a national public health service, which has been a subject of anxious consideration and much controversy for the past half century, and is still unsolved—or at least none of the solutions proposed has yet been adopted. How this ties in with the organization and needed reorganization of the entire administrative service of the United States is ably discussed.

For a new, broader and better co-ordinated public health service the author proposes a department of health and education with bureaus of health, education and children. The divisions in the health bureau would include quarantine, communicable diseases, scientific research and hygienic laboratory, vital statistics, hospitals (marine and others) and miscellaneous. Under communicable diseases would come interstate water supply, rural sanitation, milk, shellfish and malaria control. This plan deserves consideration in the light of the author's historical and critical review, already mentioned. The book as a whole is a distinctive contribution to health literature.

Publications Received

THE CUBAN HURRICANE of Oct. 26, 1926, is the subject of a 154-p. illustrated report published by the Secretaria de Obras Publicas, Republica de Cuba, Havana, Cuba. The report contains a description of the hurricane, the planning of the reconstruction work and the manner in which this work was carried out.

RIVER REGULATION in New York State is the title of a pamphlet published by the Empire State Gas & Electric Association, Grand Central Terminal, New York City. It deals with the menace of "flashy" rivers and the advantages to be gained from the construction of storage reservoirs upon the headwaters of such rivers. The state's policy in regard to river regulation is outlined in the pamphlet.

SEWAGE AND WATER TREATMENT PROBLEMS in relation to the pollution of Lake Michigan are discussed in the 47-page report of the Lake Michigan Sanitation Congress. Sewage treatment at Chicago, the Indiana and Michigan sanitation programs, the Waukegan water filtration plant, and the quality of water at different points on the south end of the lake are the principal subjects included. (Office of the Congress, 9046 Commercial Ave., Chicago.)

DEVELOPMENT OF NAVIGABLE WATERS in Poland, the utilization of the maritime outlets and of the routes of access thereto for coal traffic, also the drinking water supply of Upper Silesia, are given in a report to the League of Nations by a committee of experts headed by James S. Case, consulting engineer, New York (Publication of the League of Nations, Geneva, VIII, 1927, VIII-2). The same committee also made a report on the drainage of the marshes of Polesia (Publication of the League of Nations, Geneva, VIII, 1927, VIII-1).

THE PORTS of Norfolk, Portsmouth and Newport News, Va., are described in Port Series No. 15, the most recent publication of the series of papers relating to the ports of this country being published by the Corps of Engineers, U. S. Army, and the U. S. Shipping Board. Like its predecessor, the report gives full information with regard to port and harbor conditions, port customs and regulations, and port services, also the foreign and domestic commerce handled. ($1.15 from Superintendent of Documents, Washington, D. C.)

THE WATER POWERS OF CANADA are described in an illustrated pamphlet published by the Water Power and Reclamation Service, Ottawa, Ont., Canada (Water Resources Paper No. 60). The report gives a general review of available and developed water power and of the more important industrial uses to which it is being put. It also includes a section outlining the methods of investigation and administra-

tion practiced by the Department of the Interior, with a synopsis of the water power laws in force in each province. The pamphlet contains five tables, thirteen plates and many views. It can be obtained free from the Director, Water Power and Reclamation Service, Ottawa.

STRAIGHTENING THE CHICAGO RIVER through a congested district to permit the opening of new thoroughfares, one of Chicago's big municipal projects, is the title of a 214-p. book (Municipal Reference Library, City Hall, Chicago, $2). The record is lengthy, giving in full property valuations, the enabling ordinance, the report of a citizens committee, cost estimates and a mass of correspondence. There are also maps and plans of the project, which was authorized by a city ordinance in 1926 through the work of Mayor Dever and a citizens committee appointed to reconcile values of property among numerous owners and also to arrange exchanges of property severed by the new channel. As this property is largely occupied by the yards and terminals of several railways, these exchanges were necessary to give logical and convenient layouts of the property on each side.

MEASURING MUNICIPAL GOVERNMENT and the Preparation of a Long Term Financial Program are the latest additions to a series of publications by Municipal Administration Service, "a non-partisan clearing house of information on all phases of municipal administration, established to serve research bureaus, public officials, leagues of municipalities, libraries and other organizations and individuals working for the betterment of municipal government." The work of this organization is directed by a governing committee from the National Municipal League and the Governmental Research Conference. Three earlier publications than the two noted above are: Governmental Research, Past, Present and Future; The Preparation and Revision of Local Building Codes; and State Administrative Review of Local Budget Making (15c. for the first and 25c. each for any of the others mentioned above, from National Municipal League, 261 Broadway, New York City). The pamphlet (88 pp.) on Measuring Municipal Government is by Clarence E. Ridley, and presents "suggested standards for measuring the results of fire, health, police and public works departments." Besides text, this pamphlet includes score rates for some of the departments considered, statistical summaries for a few cities, and a bibliography. The pamphlet (28 pp.) on The Preparation of a Long-Term Financial Program is by C. E. Rightor, chief accountant, Detroit Bureau of Governmental Research, and secretary, Mayor's Committee on Finances, City of Detroit. It discusses the need for public improvements, budget limitations, relations to city planning, experiences with long-term planning, and outlines long-term planning procedure, including departmental estimates, revenue estimated, the correlation of the two, public hearings and revision of the program in years after its adoption. Illustrations in tabular form are included.

New Books and Revised Editions

[*Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.*]

CALIFORNIA IRRIGATION DISTRICT LAWS—Compiled by Legislative Counsel (Edward Hyatt, State Engineer, Sacramento, Calif.). Paper; 6x9 in.; pp. 230.

Includes 1927 additions and amendments. Contains list of active irrigation districts as of July 1, 1927.

CHART FOR APPROXIMATE STRESS DETERMINATION IN REINFORCED CONCRETE CHIMNEYS—By Peter Gillespie, Professor of Civil Engineering, and W. K. Irwin, Research Assistant, Faculty of Applied Science and Engineering, School of Scientific Research. Paper; 6x9 in.; pp. 27. One halftone and 18 diagrams. Toronto, Ont.: University of Toronto Press.

COMMERCIAL SURVEY OF THE SOUTHEAST—By John M. Haver, Domestic Commerce Division, U. S. Department of Commerce. Cloth, 6x9 in., pp. 477; folding map on many pages. $1. From Superintendent of Documents, Washington, D. C.

COMPARATIVE TAX RATES OF 249 CITIES, 1927—By Charles E. Rightor, Chief Accountant, Detroit Bureau of Governmental Research. Reprint from National Municipal Review, December 1927. Paper 6x9 in.; pp. 14 tables.

Continuation of a series showing, among other things, population as of July 1, 1926, assessed valuation, percentages of realty and personalty; tax rates for city, school, county, state, and totals; and three columns of correction figures in order to give in the fourth the "final readjusted tax" on a comparative basis.

DEDICATION of the New Home of the Engineers Club of San Francisco. Paper; 9x12 in.; pp. 15; halftones.

Besides exterior and interior views of the new club, list of officers and congratulatory telegrams, this pamphlet contains the dedication address by the president of the club, Nathan A. Bowers, Pacific Coast editor of *Engineering News-Record*.

DRUCKVERTEILUNG ERDDRUCH, ERDWIDERSTAND TRAGFAHIGKEIT—Von Dr.-Ing. Heinrich Pihera, Teplitz-Schönau. Vienna: Julius Springer. Paper; 6x9 in.; pp. 92; 51 line cuts in text and six plates of diagrams. 9 reichmarks in Austria.

ELEMENTARY BUILDING SCIENCE—By Alfred Everett, M. I. Struc. E.; Head Master, Day Technical Schools, L. C. C. School of Building, Brixton. London: Humphrey Midford. New York: Oxford University Press, American Branch. Cloth; 6x9 in.; pp. 159; 85 line cuts. $2.50.

A British textbook dealing with the "application of physics and chemistry to buildings and building materials, and related problems."

HEATING AND VENTILATION: A handbook for Architects and Engineers—By C. W. Brabbée—Translated for American Use from the Seventh German Edition of Rietschel-Brabbée "Geizungs- und Lüftungstechnik." New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 333; 187 figures in the text, 1 folding plate and 6 folding "charts" (tables) in pocket. $4.50.

HEAT TRANSMISSION THROUGH BOILER TUBES—By Huber O. Croft, Assistant Professor of Mechanical Engineering, University of Illinois. (Experiment Station Bulletin No. 168). Urbana, Ill.: University of Illinois. Paper; 6x9 in.; pp. 59; 17 linecuts and several tables. 30c.

THE IRRIGATION SERVICE (OF EGYPT): Its Organization and Administration—By P. M. Tottenham, C.B.E. (Ministry of Public Works, Egypt). Paper; 8x13 in.; pp. 87; large folding map. Cairo, Egypt; Government Publication Office. Price P.E. 20.

Gives history, description of work, statistics and higher personnel from 1884 on.

LOSSES AND DAMAGES Resulting from the Floods of 1927: Mississippi River and Tributaries, in the States of Illinois, Missouri, Kentucky, Tennessee, Arkansas, Mississippi and Louisiana. Memphis, Tenn.: Mississippi River Flood Control Association. Paper; 6x9 in.; pp. 213, folding map.

A MODEL CITY CHARTER. With Home Rule Provisions Recommended for State Constitution—Prepared by the Committee on Municipal Programs of the National Municipal League. Revised, 1927. New York: National Municipal League, 261 Broadway. Paper; 6x9 in.; pp. 77.

A revision of the 1916 model charter, both being charters of the council-manager type.

PORTLAND CEMENT CONCRETE OF UNUSUAL CHARACTER: For Water-proofing, Lightweight Installation, Quick-hardening, Antifreeze, Plasticizing, Soundproof, and Other Unusual Purposes. Bulletin No. 23, Kansas City Testing Laboratories, 700 Baltimore Ave., Kansas City, Mo. Paper, 6x9 in.; pp. 22; illustrated.

STANDARDS AND SPECIFICATIONS IN THE WOOD-USING INDUSTRIES: Nationally Recognized Standards and Specifications for Wood and Manufactures Thereof, Including Paper and Paper Products. U. S. Dept. of Commerce, National Bureau of Standards, George K. Burgess, Director. Cloth; 7x11 in.; pp. 349; 145 linecuts. $1.50 from Superintendent of Documents, Washington, D. C.

In half dozen parts: Timber and other unmanufactured or partly manufactured wood, including rough hewn, sawed and surfaced; lumber for building and factory use; manufactures of wood (other than furniture); furniture; paper; miscellaneous, and list of some 75 societies and associations issuing standards and specifications in this field. Dimensioned cross-sections of mouldings, sideboards, etc. are given. Promises to be notably useful for producers, dealers and users.

STATE REGULATION OF PUBLIC UTILITIES IN ILLINOIS—By Charles Mayard Kneier, Ph. D., University of Texas (University of Illinois Studies in the Social Sciences, Vol. 14, No. 1), Urbana, Ill.; University of Illinois. Paper; 7x10 in., pp. 226. $1.50.

Reviews legislation on the subject, organization and method, rate regulation, service rendered, accounting and reporting, including security issues, and finally, local regulation of public utilities. Supported by tabular data and supplemented by numerous references.

STEAM TURBINES—By Edwin F. Church, Jr., Professor of Mechanical Engineering, Polytechnic Institute of Brooklyn. (First Edition) New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 273. 225 halftones and line cuts. 17 tables. $3.

TRADE ASSOCIATION ACTIVITIES—Prepared by Irving S. Paull, J. W. Millard and James S. Taylor, U. S. Department of Commerce. Cloth, 6x9 in.; pp. 381. 75c. from Superintendent of Documents, Washington, D. C.

TRUCK FACTS FOR 1927—National Automobile Chamber of Commerce. Paper; 6x9 in.; pp. 52.

Statistics and other information on registration and ownership, commodities carried, types of vehicles, interstate operation, taxation, etc.

News of the Week

Current Events in the Civil Engineering and Contracting Fields

Civil Engineers Open Seventy-Fifth Annual Meeting

Board Plans Expansion of Technical Activities—Will Participate in Louvain Memorial

ALL but one of the members of the Board of Direction of the American Society of Civil Engineers were present at the meeting that opened on Jan. 16 preceding the seventy-fifth annual meeting of the society.

The board adopted a budget for 1928 and recommended it to the incoming board, which convenes for its first meeting on Jan. 19. This budget includes provision for participation in the Louvain Memorial to the American engineers who lost their lives in the World War. Provision was made also for a contribution toward the work of the Society for the Promotion of Engineering Education in research in engineering education.

The Committee on Professional Conduct recited some of the unfortunate experiences of engineers engaged in foreign work and indicated subjects that should be investigated by members of the society contemplating foreign work. It analyzed the contracts of employment used by several concerns engaged in such work and submitted a suggested form for a simple contract covering the principal points.

In answer to inquiries from members the committee ruled on two hypothetical questions involving professional ethics. These will be treated in detail in a subsequent issue.

On recommendation of the Committee on Public Relations the Board directed that communications be sent to the President of the United States, the Secretary of the Interior, the Director, U. S. Geological Survey, and other public officials, endorsing the provisions of the Newton Bill which provides for increased appropriations for the U. S. Geological Survey in gathering stream-flow data. The president was authorized to appoint a committee to appear at hearings on the subject.

Technical Expansion Authorized

The president was authorized to appoint a special committee of seven on technical expansion charged with the duty of studying and reporting on the present organization and conduct of the technical activities of the society and on a proposed plan of organization through which to stimulate, supervise and co-ordinate all the technical activities of the society. Special attention is to be given by this committee to strengthening the work of the committees and technical divisions and to provide a sound basis for the expansion of the society's technical work. The committee is to report at the summer meeting of the board.

The committees on Aims and Activities, on Engineering Contract Bonding, on Arbitration and on Standard Construction Contracts were discharged, with the thanks of the board, their work having been completed for the present.

The board adopted an interpretation of the terms "professional" and "sub-professional" work in connection with the records of applicants, defining the degree of responsibility involved and providing that each year of sub-professional work shall be equivalent to one-half year of professional work in figuring time of "active practice."

Approval was given to the formation of student chapters at Mississippi Agricultural and Mechanical College and South Dakota State School of Mines.

Future meetings of the society were provided for as follows: Dates fixed—1928, Spring, Washington, D. C.; Annual Convention, Buffalo, N. Y.; Fall, San Diego, Calif.; 1929, Spring, Dallas, Texas; Annual Convention, Milwaukee, Wis.; Fall, Boston, Mass. Dates tentatively fixed: 1930, Spring, Sacramento, Calif.; Annual Convention, Toronto, Ont.; Fall, St. Louis, Mo.; 1931, Spring, Florida; Annual Convention, Rochester, N. Y.; Fall, French Lick, Ind.

George W. Fuller was appointed to represent the society on a nucleus committee to form an American committee on participation in the World Engineering Congress to be held at Tokyo in October, 1929.

Charles S. Churchill was appointed to represent the society on a joint committee to recommend to the founder societies as to their appropriate participation in the celebration of the 200th anniversary of the birth of George Washington in 1932.

Early Vote Sought on Express Highway Commission Plan

A special rule for the Furlow resolution providing for a commission to consider the feasibility of building express highways will be considered shortly by the House Committee on Rules. The Furlow plan calls for building by private capital toll roads to handle express traffic, the roads to become federal property when they have paid for themselves. These express highways would connect centers of population by direct routes over new rights-of-way and without grade crossings. The first link in the proposed system would run from New York to Bridgeport, New Haven and Hartford, Conn., then to Springfield, Worcester and Boston, Mass.

Large Construction Firms Form Huge Single Organization

New Company, United Engineers & Constructors, Inc., Will Operate All Over the World

WHAT is perhaps the largest construction firm in the world has been organized through the merger of four large companies in the construction field: The Public Service Production Company, of Newark, New Jersey; the U.G.I. Contracting Company, of Philadelphia; Day & Zimmermann Engineering & Construction Company, of Philadelphia, and Dwight P. Robinson & Company, of New York. The new company will be known as the United Engineers & Constructors, Inc., and has been formed to operate in any part of the world, engaging, according to its announcement, "in every form of engineering and construction activity." The principal office of the company will be in Philadelphia, with branch offices in the following cities: New York, Newark, Chicago, Los Angeles, Atlanta, Houston, Pittsburgh, Montreal, Rio de Janeiro and Buenos Aires.

Formation of the new company has been largely the work of the United Gas Improvement Company, of Philadelphia, and the Public Service Corporation of New Jersey, which are controlled by the same interests. Dwight P. Robinson will be head of the company, with the following as directors: Arthur W. Thompson, president of the U.G.I. Company; Thomas N. McCarter, president of the Public Service Corporation; Samuel T. Bodine, chairman of the board of the U.G.I.; Paul Thompson, a vice-president of the same company and president of the Philadelphia Gas Works Company, and John E. Zimmermann, president of Day & Zimmermann, Inc.

The merger of these four companies brings into use a contracting background of some 45 years, the oldest company in the merger being Dwight P. Robinson & Company, which a number of years ago absorbed Westinghouse, Church, Kerr & Company, railroad and industrial builders. Day & Zimmermann was formed 25 years ago and has specialized in the design and construction of public utility plants. The U.G.I. Contracting Company was formed in 1919, and its specialty has been in utility and hydro-electric work. The Public Service Production Company was formed in 1922 as the contracting branch of the Public Service Corporation of New Jersey, though it has not confined its construction work to industrial plants managed by the parent company.

W. W. Freeman Awarded McGraw Co-operation Medal

At a dinner held at the Hotel Roosevelt, New York City, Jan. 10, W. Winans Freeman, chairman of the Union Gas & Electric Company, Cincinnati, and vice-president of the Columbia Gas & Electric Company of New York, was presented with the James H. McGraw Award Medal for Co-operation. The medal was given to Mr. Freeman in recognition of his eight years of service as president of the Society for Electrical Development. Mr. McGraw himself made the presentation.

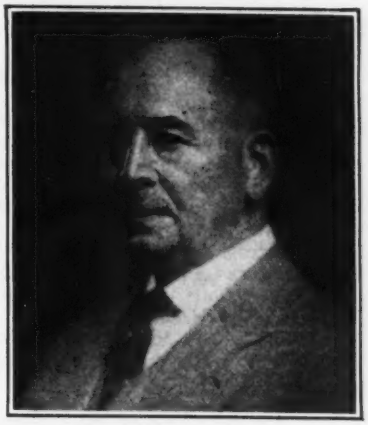
The James H. McGraw Award, offered in the form of four medals given separately to men in the electrical industry, was created by James H. McGraw, president of the McGraw-Hill Publishing Company, and each consists of a bronze medal and a purse of $100 in gold. The four annual presentations are the manufacturer's medal which is given at the summer meeting of the National Electrical Manufacturers Association, to that employee or official of any manufacturing organization in the United States or Canada who is judged to have made the most constructive contribution to the advancement of the electrical manufacturing industry; the jobber's medal given at the winter meeting of the Electrical Supply Jobbers to that man who is judged to have made the most constructive contribution to the advancement of electrical jobbing; the contractor-dealer's medal given at the annual convention of the Association of Electragists—International to that employee or official contributing most constructively to the advancement of its particular industry and the medal for co-operation given at a special dinner meeting of representatives of all branches of the industry.

The awards were established in 1925 and the first medal and purse for co-operation was given to J. Robert Crouse, president of the Nizer Corporation of Detroit. No medal for co-operation was given in 1926.

Income from an endowment administered by the Society for Electrical Development assures the yearly awards.

Reciprocal Membership Proposed by Western Society

Reciprocal transfer of membership between local societies is provided for by a new by-law of the Western Society of Engineers, and other societies are being asked to take similar action. For example, a member of a society in Detroit who might move to Chicago could transfer his membership to the Western Society of Engineers without paying an entrance fee. Another step towards co-operation is the appointing of a committee representing the principal engineering societies of Chicago, to arrange for reducing duplication of energy by joint planning of programs, joint secretarial service, joint use of meeting rooms and library, and joint committees on local matters of public importance.



COLONEL LINCOLN BUSH

Col. Lincoln Bush Elected President of Civil Engineers

New Head of Am. Soc. C. E. Has Had Brilliant Record as Bridge Engineer—War Work

COL. LINCOLN BUSH, who was elected president of the American Society of Civil Engineers at the opening of its annual meeting yesterday (Jan. 18) in New York City, was born Dec. 14, 1860, in Cook County, Ill. He attended the country schools and the normal school in that county from which latter institution he received an M.A. degree in 1880. He remained as an instructor for four years and then entered the University of Illinois, from which he was graduated in 1888, with the degree of bachelor of science in civil engineering.

Col. Bush started his professional career with the Union Pacific Railway, where he remained on location work for three years, being then appointed assistant instructor in mathematics at the University of Illinois. He was also assistant engineer on shop and field inspection of bridges for Morison & Corthell, consulting engineers of Chicago. For the next four years he was assistant engineer on design and estimates of bridges of the western office of the Pittsburgh Bridge Company, and then served for a half year as assistant engineer on masonry design for bridges of the Chicago Drainage Canal Board.

In 1897 Col. Bush resumed his railway work, being made assistant to the bridge engineer, and acting division engineer of the Chicago & North Western Railway. In 1900 he joined the engineering staff of the Delaware, Lackawanna & Western Railroad. From bridge engineer he was promoted to the position of principal assistant engineer, and, finally, chief engineer.

During his association with the Lackawanna, Col. Bush was instrumental in rebuilding and modernizing many of the facilities of that company. He is the inventor of the Bush train shed and Bush type of concrete roadbed construction. He also made practical and economic use of confined sand for lowering great weights through long distances with safety and certainty. From 1909 to 1925, except for two years World War service, he has been a consulting engineer and contractor, principally on railroad terminal facilities, bridges and public utility facilities. He also has served several contracting companies as chief engineer.

His war service included important work as associate officer in charge of engineering, Construction Division of the Army, during which time he organized and took personal charge of major projects, such as the seven terminal ports on the Atlantic and Gulf Seaboards and the fourteen warehouses at interior industrial centers, twenty-one major projects which involved a total expenditure of $234,000,000. He was commissioned a colonel in the Quartermasters Corps, U. S. A., August 24, 1918.

Col. Bush served the American Society of Civil Engineers as vice-president in 1924-1925, as treasurer in 1915-1916, and as director in 1912-1914. He is also a member of the American Western Society of Engineers and the Engineers Club of New York.

Other officers elected were: vice-presidents, George W. Fuller and Louis C. Hill; directors, R. E. Dougherty, Malcolm Pirnie, Harrison P. Eddy, Morris Knowles, James H. Johnston and Frederick H. Fowler.

Scranton Gas & Water Co. Sells to Federal Corporation

Control of a majority of the stock of the Scranton Gas & Water Co., which with subsidiary companies serves both water and gas to Scranton, Pa., and other places in the Lackawanna Valley, has been obtained by the Federal Water Service Corporation of New York City. The Scranton Company states that the Federal Water Service Corporation's offer to pay $295 a share for the stock of the Scranton company, payment to be made March 20, 1928, has been accepted by a large majority of the stockholders

It is reported that the stock of the Scranton Gas & Water Co. is in 84,000 shares. At $295 a share, this would make $24,780,000 for the entire stock. In addition, the purchaser is to assume the $2,925,000 bonded indebtedness of the Scranton company, making the purchase price $27,705,000.

Last September the Federal Water Service Corporation bought at $150 a share the majority of the stock of the Spring Brook Water Supply Co., supplying Wilkes-Barre and vicinity, this company supplying nearly the entire Wyoming valley. The water-collecting grounds of the Scranton Gas & Water Co. and the Spring Brook Water Supply Company adjoin.

Am. Soc. C.E. Awards Prizes and Medals at Annual Meeting

B. F. JAKOBSEN, who received the Norman gold medal for his paper "Stresses in Thick Arches of Dams" is a consulting engineer with offices in the de Young Building, San Francisco, Calif. Mr. Jakobsen was born in Hjoring, Denmark, in September, 1881, and graduated as electrical engineer from the Mittweida Technical Institute, Germany, in 1902. This was followed by one year at the University of Dresden.

His professional career covers five years as junior and assistant engineer with the U. S. Reclamation Service on the Salt River and on the Elephant Butte projects. On the Salt River project his work covered design and supervision of construction and on the Elephant Butte project he was assistant to the chief designing engineer. After leaving the Reclamation Service he was employed as electrical engineer in connection with the Cerro de Pasco Mining Company's hydro-electric power development in Peru and as designing engineer in connection with the Homestake Mining Company's hydro-electric development at Lead, S. D.

From May, 1919, to September, 1922, Mr. Jakobsen was designing engineer in charge for the San Joaquin Light and Power Corporation, Fresno, Calif., having charge of designs for the Kerckhoff Power Development and the Kern River Power Development. Since September, 1922, he has been employed as consulting engineer by the Feather River Power Company of San Francisco, and in connection with the dams for the Los Angeles County Flood Control District.

He is the author of numerous technical papers.

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H. C. RIPLEY, whose paper on "The Relation of Depth to Curvature of Channels," won for him the J. James R. Croes Medal, is a graduate of the University of Michigan, Class of 1870. The degree of doctor of engineering was conferred on him by that same institution in 1913. Mr. Ripley's first work was as assistant engineer on hydrographic surveys and marine construction on Lake Michigan, Red River, Louisiana, and the Gulf of Mexico. After 20 years service in the United States Engineering Department he entered consulting work, planning improvements at Coatzcoalcos, Salina Cruz, and Manzanillo harbors, Mexico. He also made examination of the ports of Tampico and Vera Cruz, Savannah, Ga., and Cumberland Sound, Ga. and Florida, and surveyed and made plans for an artificial harbor at Istapa, Guatemala.

Later Mr. Ripley was engaged by the Isthmian Canal Commission to explore the Pacific side of the isthmus prior to the canal construction. He was also a member of the board of engineers which devised the plans of improvement of the entrance to Aransas Pass in Texas, and was a member of the board of engineers which devised a plan for the protection of Galveston.

Mr. Ripley is the author of a number of technical articles on fore-shore protection.

* * *

L. S. STILES, awarded the Thomas Fitch Rowland prize for his paper on "Pipe Tunnel Under Gowanus Canal, Brooklyn, N. Y.," was born in Philadelphia, where he attended the public schools, and later the Philadelphia Manual Training School. After attending Temple College he began his career with I. P. Morris Company of Philadelphia, serving an apprenticeship in the pattern, foundry and machine shops on stationary hoisting and pumping engines, marine boilers and large marine engines, later working in the drafting room. In some years he joined the William Cramp Engine & Ship Building Company as assistant to the plant engineer. After several years at that company he was employed by the United Gas Improvement Company of Philadelphia as junior engineer.

The next employment of Mr. Stiles was with the Brooklyn Union Gas Company. During the first four years he was assistant to the chief engineer, later becoming construction engineer, the position which he now holds.

In addition to new work and reconstruction Mr. Stiles has had charge of various improvements in water gas generators, which has resulted in increasing their capacity considerably. These gains have been obtained by substituting larger connections throughout, use of higher blast pressures, installation of hydraulic control for operating the sets, and of, latterly, electric control, which operates the generators automatically.

Mr. Stiles is a member of the American Society of Mechanical Engineers, the American Gas Association, Illuminating Engineering Society and the Brooklyn Engineers Club.

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JOHN R. BAYLIS, filtration engineer, Department of Public Works, city of Chicago, whose paper on "Corrosion of Concrete" won for him the James Laurie prize, was born May 11, 1885. He was graduated at the Mississippi Agricultural and Mechanical College in 1905 with the degree of bachelor of science and began his professional career as foreman on construction for the International & Great Northern Railroad Company. After a short period of employment on bridge work for the Trinity & Brazos Valley Railroad he entered the service of Walter G. Kirkpatrick, consulting engineer of Jackson, Miss. It was there he started his career in the field of waterworks engineering.

In 1912 Mr. Baylis became a member of the firm of Kirkpatrick, Culley, McCorkle & Baylis, consulting engineers. From 1915 to 1917 he was manager of the Jackson, Miss., waterworks and did all the chemical and bacteriological work in connection with the operation of the filter plant.

In January, 1917, he became affiliated with the Baltimore City Water Department where he was successively bacteriologist, chemist, analyst and principal sanitary chemist of the Montebello filters. In September, 1926, he was made physical chemist, Division of Water Safety Control of the Chicago Bureau of Engineering and put in charge of experimental work on the filtration of Lake Michigan water for Chicago. From April, 1927, to date he has been filtration engineer with the same duties as when physical chemist. He designed the Chicago experimental filtration plant.

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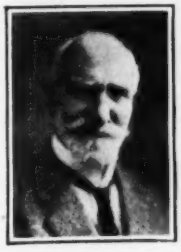
JOHN A. MILLER, awarded the Arthur M. Wellington prize for his paper on "Increasing the Efficiency of Passenger Transportation in City Streets," is a native of New Jersey, having been born Sept. 20, 1895, at Newark. He attended Newark Academy, and was graduated from civil engineering at Sheffield Scientific School, Yale University, in 1915. Immediately after graduation Mr. Miller entered the employ of the Public Service Railway of Newark, as cadet engineer. He worked as rodman and transitman in the track department, as test engineer in power stations, as shopman in the mechanical department, and as lineman in the electric distribution department.

During the World War Mr. Miller served overseas with the 104th Engineers, being discharged from the service with a commission as first lieutenant. Returning to the employ of the Public Service Railway he worked as car timer, motorman, conductor and assistant supervisor of the Montclair Division, later being made special instructor in safety car operation at

(*Continued on p. 129*)

Charles D. Marx Made Honorary Member of Am. Soc. C.E.

Charles D. Marx, who was elected to honorary membership yesterday at the annual meeting of the American Society of Civil Engineers in New York, is a past-president of the society and professor emeritus of civil engineering at Stanford University.



Professor Marx was born at Toledo Oct. 10, 1857. From 1863 to 1866 he had private instruction in Amsterdam, Holland, where his father was American consul. He studied in the public schools at Toledo and from 1871 to 1876 was a student at the Karlsruhe (Baden) Realgymnasium, from which he was graduated in 1876. Again returning to this country he entered Cornell from which he received a bachelor of science degree in civil engineering in 1878. He again returned to the continent where he entered the Karlsruhe Polytechnic, passing the examinations as civil engineer in 1881.

His first professional work was with the Boston Hoosac Tunnel and Western Railroad. He then entered the service of the Engineer Corps, being U. S. Assistant Engineer first on the Missouri and later on the Mississippi river improvement. In 1884 he was made assistant professor of civil engineering at Cornell, where he remained until 1890. Between 1884 and 1890 he was chief inspector of public improvements in Rochester, N. Y., and also principal assistant engineer to the late Emil Kuichling on a number of projects. In 1890 he accepted a call to the chair of civil engineering at the University of Wisconsin, from which he transferred in 1891 to Stanford University.

During his California residence Professor Marx has been connected with a number of important projects as consulting engineer. He was the first chairman of the State Water Commission and had a large part in framing the water laws of that state. He has been a town trustee, president of the board of trustees, and chairman of the Board of Public Works of Palo Alto for a number of years. He is a member of a number of technical societies and clubs and one of his important committee memberships is the chairmanship of the Arch Dam Committee of Engineering Foundation. He holds an honorary degree of Doctor of Laws from the University of California and that of Doctor of Engineering from the Technical High School of Karlsruhe.

Engineer Sues North Jersey Water Supply Commission

George A. Johnson, consulting engineer of New York, has filed suit against the North Jersey District Water Supply Commission to recover $612,435. The complaint of Mr. Johnson charges breach of contract in connection with his employment on the Wanaque aqueduct work. The history of Mr. Johnson's employment and subsequent dismissal by the Water Supply Commission was contained in *Engineering News-Record* May 19, 1927, p. 832, and Aug. 11, 1927, p. 239.

Brief News

INCLUSION OF THE PITTSBURGH territory in the consideration of any federal plan of flood control has been recommended to the flood-control committee of the House of Representatives by a Pittsburgh delegation. George F. Davison, past-president of the American Society of Civil Engineers, urged the establishment of a fixed national policy for the solution of the flood problem, but specified that such a policy must put all sections in the valley on an equal footing. It is the contention of this Pittsburgh delegation that the control of the lower Mississippi and the control of the upper Ohio are inseparable.

APPROVAL HAS BEEN GIVEN THE CONSTRUCTION of the bridge over Kill van Kull near Bayonne, N. J., and over the Delaware River at Palmyra, N. J., by the War Department. The Kill van Kull bridge application was made by the Port of New York Authority for approval of plans of a bridge to be constructed under an act of Congress approved March 2, 1925. The bridge over the Delaware is to be constructed by the Tacona-Palmyra Bridge Company of Palmyra, N. J.

HEARINGS ON THE PROPOSED STATE HIGHWAY BRIDGE across the Hackensack River, New Jersey, are scheduled to be held before the Board of Army Engineers, New York City, Feb. 7. This bridge would be 2,900 ft. north of the present Lincoln Highway bridge with two approach spans from the east and five from the west.

DATE FOR ELIMINATING CROSS-CONNECTIONS in New Jersey between approved water supplies for potable purposes and unapproved sources, when protected by double check values of the factory, Mutual Fire Insurance type, was postponed from Jan. 1, 1928, until after the meeting, next June, of the New Jersey Department of Health, with the understanding that meanwhile an investigation will be made of the "improved fire service check valve." (Factory Mutual Record, May, 1927). All other cross-connections were outlawed some two years ago.

MORE THAN $54,500.00 WILL BE SPENT by the Northern Pacific Railway Company in 1928 for maintenance, roadway and building improvements, and the completion of two branch-line projects. Equipment will take $17,500,000, roadway and building maintenance $13,000,000 and improvements $10,000,000.

U. S. Chamber Opposes Boulder Dam Bill

The United States Chamber of Commerce has laid before the House committee on irrigation and reclamation its opposition to the Boulder Dam project as provided for in the Swing bill. The opposition was presented by Lewis Pierson, president of the Chamber, who asserted that although the Chamber had not adopted by referendum or resolution at an annual meeting an opinion on the specific project, it has laid down a general principle which covers the proposal. That principle is that the federal government should refrain from entering any phase of business that can be successfully conducted by private enterprise.

Am. Soc. C. E. Awards Medals

(*Continued from p. 128, col. 3*)

Paterson, and instructor at the trainmen's school at Hoboken, N. J. In January, 1921, he was made traffic investigator of the Public Service Railway, a position which he held for two years, when he joined the editorial staff of the *Electric Railway Journal*, one of the McGraw-Hill publications. Mr. Miller is also editor of AERA, the official publication of the American Electric Railway Association.

* * *

WILLIAM BREUER, who was awarded the Collingwood Prize for his paper on "Trend of Cost of Certain Public Utilities," has been employed by Day & Zimmermann, engineers of Philadelphia, New York and Chicago since he began his professional work in 1916 at the age of 19. Mr. Breuer was an engineer officer during the World War, rejoining the staff of Day & Zimmermann after discharge from the military service.

For the past nine years Mr. Breuer has specialized on valuation and cost data work, having held the positions of assistant statistician, assistant to an advisory engineer, and field estimator on power-plant construction. He then was employed on valuation work entirely. His specialty has been in valuation work on electric, street railway, gas company and other public utilities.

Rochester Regional Planning Commission Authorized

The Board of Supervisors of Monroe County, N. Y., on Dec. 30, authorized the formation of a county regional planning board consisting of five members to co-operate with the planning boards of Rochester, N. Y., and towns within the county. The new board will work in co-operation with the Monroe County Park Commission.

Engineering Council Holds Annual Meeting; Appoints Flood-Control Committee

Flood control, the Colorado River problem, establishment of a federal hydraulic laboratory, and labor disputes were outstanding discussions in the two-day annual meeting of the American Engineering Council held in Washington last week. Announcement was made at the meeting of the appointment of a flood-control committee to work with Congress and to study the whole national situation with a view to obviating such disasters as occurred along the Mississippi and in New England last year. Grant S. Williams, of Ann Arbor, is chairman of the committee, the other members being Dexter L. Brown, St. Louis; John R. Freeman, Providence, R. I.; and Arthur E. Morgan, president of Antioch College, Ohio. A fifth member is to be appointed. The committee will study the reports of the Chief of Engineers and the Mississippi River Commission and will prepare itself to recommend appropriate action. The committee was instructed to co-operate with the flood-control committee of the House of Representatives and to present the attitude of the American Engineering Council at Congressional hearings.

Acting upon the recommendations of its public affairs committee, the council voted its disapproval of the Swing-Johnson Bill, which provides for the construction of works, for the protection and development of the Lower Colorado River Basin, and for the approval of the Colorado River Compact. The engineers objected to that provision of the bill which establishes the "Colorado River Dam Fund" to receive advances from the government not exceeding $125,000,000 on the ground that it involves federal ownership and the sale of power.

The council voted to support the bill of Senator Ransdell which would place the proposed national hydraulic laboratory in the Bureau of Standards. Other bills now pending in Congress would assign the laboratory to the Engineer Corps and to the Mississippi River Commission.

The council's secretary, L. W. Wallace, recommended that the council suggest to the agencies that have been parties to the National Board for Jurisdictional Awards that the board be formally disbanded. This recommendation is based on the recent withdrawal of the Building Trades Department of the A. F. of L.

The council unofficially endorsed a "sound federal program to assist agriculture," and condemned the bill of Senator McKeller to establish the Muscle Shoals Commission.

Officers were elected as follows: President, A. W. Berresford, Detroit; vice-president, Gardner S. Williams, Ann Arbor, Mich., and I. E. Moultrop, Boston; treasurer, Harrison E. Howe, Washington.

Washington News

By Paul Wooton
Washington Correspondent,
Engineering News-Record

FLOOD-CONTROL legislation is still in the committee stage. Hearings have been in progress since Nov. 7 before the flood control committee of the House of Representatives, of which Frank R. Reid, of Illinois, is chairman. Three volumes of the printed record already are available and more are to come. Hearings are in a final but interesting stage, with Secretaries Davis and Hoover and General Jadwin scheduled as the last three witnesses.

With the conclusion of the hearings the House committee will begin its executive sessions at which the bill to be reported to the House will be framed. Chairman Reid's bill will be the basis for the legislation which the committee is expected to recommend.

In the Senate the basis of legislation will be the plan submitted by General Jadwin and indorsed by the administration. Senator Jones, of Washington, the chairman of the commerce committee, which has jurisdiction, is one of the administration leaders and his bill puts into legislative form the Jadwin plan.

The Senate committee expects to have only brief hearings. These will begin Jan. 23. A bill is to be reported promptly to the Senate, where there is a decided disposition to expedite the legislation.

Indications are that Congress will eliminate or reduce the amount of local co-operation called for in the Jadwin plan. A Democratic conference voted unanimously in favor of a national plan at national expense. Many Republicans are opposed to local contributions. There are practical as well as sentimental reasons for this position. The lands benefited form only a part of the land of the state. Although there are reasons why land subject to overflow should pay a part of the cost, it is obvious the flooded area alone would not be able to provide the money for 20 per cent of the new work, for rights-of-way, damages and maintenance. With floodways varying from 5 to 22 miles in width, the costs for land and for the raising of railroad and highway grades becomes a large item.

All of the alluvial land in Mississippi, for instance, constitutes only 12 per cent of the area of the state. Taxpayers on the Gulf Coast feel that they are benefited only in the general way that taxpayers generally are benefited, and it is doubtful if the necessary state authority could be secured to meet the assessment against the state, particularly when most of the money would have to be expended in another state. Since the principal beneficiaries of floodways are at distant points often in another state, a difficulty arises in pro-rating costs.

Such differences of opinion have developed in the valley as to various features of the engineering plans that no agreement seems possible.

American Institute of Consulting Engineers Holds Annual Meeting

Addition of a new clause to its code of ethics, election of officers and members of the council and addresses on arbitration by Judge Moses Grossman and Col. Charles R. Gow of Boston were features of the annual meeting of the American Institute of Consulting Engineers held in New York City, Jan. 16 and 17. At the meeting Jan. 16 the following addition to the code of ethics was formally adopted:

> It shall be considered unprofessional and inconsistent with honorable and dignified bearing for any member of the American Institute of Consulting Engineers:
>
> (14) To adopt, while serving as an expert witness before any court or tribunal, the attitude of an advocate or to express an opinion not founded on adequate knowledge and honest conviction.

Judge Grossman, honorary president of the American Arbitration Association, addressed the dinner meeting Jan. 16 on the modern types of arbitration laws and the working of them in New York, New Jersey, Massachusetts, Oregon, Pennsylvania, California and federal laws, under which an agreement to arbitrate is binding and irrevocable and wherein decisions have the same binding power as a court decision. Col. Gow recited his personal experiences with arbitration and the excellent results growing out of its use.

The following were elected to the council for the term expiring January, 1931: Howard C. Baird, New York City; Baxter L. Brown, St. Louis, Mo.; and E. P. Goodrich, New York City. At a meeting of the council at noon Jan. 17, John F. Coleman, of New Orleans, was elected president, Alten S. Miller, of New York City, vice-president, and P. W. Henry secretary and treasurer (re-elected).

St. Paul Railway Reorganization Is Approved

Approval of the plan for reorganizing the Chicago, Milwaukee & St. Paul Railway was approved by the Interstate Commerce Commission in an order issued Jan. 4 and subsequently was approved by the federal court in Chicago upon receipt of a copy of the Interstate Commerce Commission order.

Receivers for the Chicago, Milwaukee & St. Paul Railway Company, which went into bankruptcy in March, 1925, turned over the property on Jan. 15 to the new company formed by the reorganization manager. The new company is to be known as the Chicago, Milwaukee, St. Paul & Pacific Railroad Company. It has been authorized to issue the necessary securities in exchange for the securities of the former company.

The Interstate Commerce Commission was not unanimous in its approval of the reorganization plan. Approval was by a seven to four vote.

Personal Notes

P. M. DAVIS, for a number of years designing engineer in the city of Los Angeles, has accepted a position as highway engineer in Costa Rica.

H. C. MAJOR, for the past six years senior resident engineer with the North Carolina State Highway Commission, has accepted a position as manager of sales for the Southern Sand & Gravel Company of Sandford, N. C. During his connection with the state highway commission Mr. Major had charge of the construction of over $2,250,000 worth of highway work.

WALTER G. HAMMOND has been appointed engineer of buildings and zoning commissioner of Baltimore by Mayor William F. Broening. He has been actively engaged in building and contracting work for 35 years. Mr. Hammond succeeds Charles H. Osborne.

W. E. DUCKETT, highway engineer of Wright County, Minn., has been elected county highway engineer of Hennepin County. His appointment is effective as of Feb. 1. Mr. Duckett has been highway engineer of Wright County five years. Before that he was engaged as special engineer for Hennepin County, taking charge of the Lyndale Ave. road project.

GIBB GILCRIST, state highway engineer of Texas in 1923 and 1924, has been reappointed state highway engineer to succeed R. A. THOMPSON who resigned Jan. 1 to open a consulting office in Dallas. Mr. Thompson was formerly chief engineer of the railroad commissions of Texas and California and member of the Interstate Commerce Commission, Railroad Valuation Board, in charge of the Pacific District office at San Francisco. More recently he was chief engineer in charge of construction of the irrigation dam at Wichita Falls, Texas, and the Garza dam for the city of Dallas.

MARSHALL W. BROWN, associate engineer with Henry L. Shadd, consulting engineer, New York City, and formerly managing engineer for the Carter Construction Company at Chicago, is in Spain negotiating for large construction and financial projects on behalf of American clients. During the war Mr. Brown, as a colonel, was chief of the allied purchasing mission in Spain.

ROBERT R. CUMMINS, roadmaster of the Southwestern Division of the Central of Georgia has been made superintendent of the Salina Division. Mr. Cummins is an engineering graduate of the University of Alabama, and has been in railway work since graduation. He first served the Seaboard Air Line for a number of years in various engineering capacities. He then joined the engineering staff of the Georgia and Florida, from which road he went in 1909 to become associated with the Central of Georgia as draftsman in the chief engineer's office. Offices he has held with that road include assistant engineer, pilot engineer, supervisor of bridges and buildings in the Southwestern Division and the Columbia Division, roadmaster of the Macon Division, assistant train master of the Columbia Division, and roadmaster of the Southwestern Division.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 18-20, 1928.

ASSOCIATED GENERAL CONTRACTORS, Washington, D. C.; Annual Convention, West Baden, Ind., Jan. 23-27, 1928.

NATIONAL ASSOCIATION OF BUILDERS' EXCHANGES, Washington, D. C.; Annual meeting, Miami, Fla., Feb. 6-9, 1928.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Monday, Feb. 14-16, 1928.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Convention, Philadelphia, Feb. 28, 29 and March 1, 1928.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Convention, Chicago, March 6-8.

THE DETROIT ENGINEERING SOCIETY was entertained on Jan. 13 by a lecture, accompanied by motion pictures, on the manufacture of steel and steel products by George H. Richardson of the Bethlehem Steel Company.

THE WESTERN SOCIETY OF ENGINEERS has the following program: Feb. 6, "The Chicago Harbor Plan," by Rufus W. Putnam; Feb. 13, "Effect of Light on the Eye," by Dr. Bovee; Feb. 20, "Pulverized Fuel at the Calumet Power Station," by A. D. Bailey. A five-day excursion to New Orleans and the lower Mississippi Valley will start Jan. 24.

THE PROVIDENCE ENGINEERING SOCIETY was addressed on Jan. 10 by H. R. Sewell of the B. F. Sturtevant Company on "Ventilating Problems Involved in the Holland Tunnel."

THE ILLINOIS SECTION OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS, at its annual meeting in Chicago on Jan. 13, elected as officers for 1928: President, Jerome A. Moss; vice-presidents, Rufus W. Putnam and Willis J. Dean; secretary, W. G. Zimmerman, American Bridge Co., Chicago. An address on "The Economic Recovery of the Lower Mississippi Valley" was given by W. W. DeBerard, of *Engineering News-Record*.

THE INDIANA ENGINEERING SOCIETY, Indianapolis Section, recently elected W. C. Mabee, engineer of the Indianapolis Water Company, as president. Other officers named are Earl Carter, chief engineer of the Public Service Commission, vice-president; H. J. McDargh, local representative of the Portland Cement Association, secretary-treasurer; and Howard M. Stradling, electrical contractor, and Paul R. Jordan, head of Paul R. Jordan & Co., trustees.

THE OHIO ENGINEERING SOCIETY at its forty-ninth annual convention, held in Columbus, Jan. 4 and 5, elected Frank W. Jennings, president of the Jennings-Lawrence Company of Columbus, president. Other officers elected were Atlee M. Wise, Canton, first vice-president, George E. Carr, Columbus, second vice-president, and Carl L. Van Voorhis, secretary-treasurer. Principal discussions on the two-day program were given by Robert H. Simpson, Columbus city engineer, who talked on the traffic problem from an engineering standpoint; by Captain W. A. Stevens of Wright Field, who spoke on the increasing use of aerial photography in mapping; C. A. Whipple, assistant chief engineer of the Hocking Valley Railway Company, who described the construction of the new line of that railroad from Gregg to Valley Crossing and George F. Schlesinger, Ohio highway director, G. J. Kane, grade separation engineer of the same department, Senator John S. Edwards, and W. A. Alsdorf, executive secretary of the Ohio Good Roads Federation.

THE SOCIETY OF TERMINAL ENGINEERS, NEW YORK CITY, held a meeting Jan. 10 at which time General A. E. Dalton, president, Merchant Fleet Corporation, gave an address on "Federal Ownership and Regulation of Terminals." At the same time the following officers for the ensuing year were installed: President, Billings Wilson; vice-presidents, Leray E. Dale, F. C. Horner, George F. Nicholson, Thomas C. Powell, John W. Weigt; and secretary-treasurer, Charles H. Newman.

Obituary

WILLIAM SCHWANHAUSSER, chief engineer of the Worthington Pump & Machinery Corporation, died on Jan. 15 in Peck Memorial Hospital, Brooklyn, after an illness of six months. Mr. Schwanhausser was born 73 years ago in Wurzburg, Bavaria, and received his degree of Mechanical Engineer at the Polytechnic Institute in Mittweida, Saxony, in 1874. On coming to this country he was employed by Osterheld & Eichmeyer, of Yonkers, N. Y., assisting in the development of engines, pumps, typewriters, the Eichmeyer electric motor and agricultural reapers and mowers. Later, as assistant general superintendent of the Otis Elevator Company for eight years, he worked on the improvement of the hydraulic elevator. In 1885 Mr. Schwanhausser took charge of the making of trade pumps for the Worthington Hydraulic Works, then in Brooklyn. He was chosen in 1895 to direct the Worthington plant in Germany, and soon added to the reputation of its pumps by introducing compound and triple expansion engines and a device for returning to the boilers steam previously wasted.

Construction Equipment and Materials

A Section Devoted to What the Manufacturer Is Doing for the Engineer and Contractor

Cleveland is Host to Largest Road Show—I

Exhibits of Highway Equipment and Materials Eclipse All Former Records—Second Class Roads Equipment Increases and Transportation Developments Are Notable

Engineering News-Record Staff Report

REGARDLESS of location the Road Show continues to grow in size. The 1928 show in Cleveland, January 9-13, represented the first venture outside of Chicago for many years and, held in conjunction with the 25th annual meeting of the American Road Builders Association, it broke all records with a total of 338 exhibits; in 1927 there were 305 and in 1926 only 288 exhibits.

The 1928 Road Show used nearly all of the 150,000 sq.ft. of space available in the three contiguous buildings, the Auditorium, the West Wing Building and the Armory. From all reports relating to service for exhibitors, handling of visitors, and sales, the 1928 show can be measured as a success; registration totaled approximately 20,000.

Special exhibits showing road systems and programs were maintained by the Bureau of Public Roads, Mexico, Dominican Republic, Alaska, the American Association of State Highway Officials, Georgia, Idaho, Pennsylvania, South Carolina, and Virginia.

Before reporting details of the many machines and materials, a few general observations can be made regarding the show as a whole.

Trends

IF ONE development stood out at the 1928 show, and there were a number that did, it was the increased stress placed on mobility and traction of equipment, in short on transportation. Motor truck manufacturers have accepted the fact that highway construction and maintenance requirements necessitate special haulage equipment, and many new trucks are the result. Heavy duty trucks for construction, lighter units for maintenance, dual tires, special springs, six-cylinder engines, special transmissions providing extra power at low speed in addition to a high traveling speed are some of the newer tendencies.

Cranes and shovels mounted on trucks continue to develop. In line with this transportation tendency is the increased use of heavy duty trailers for moving such equipment as pavers and power shovels. Crawlers for rear traction on motor trucks promise to make them more useful on soft ground, while the application of crawlers to trailer units not only extends their field of operation but permits an increase in their size.

With the increasing stress being placed on the construction and maintenance of second class roads, there appeared exhibits of chip spreaders, sand spreaders, and gravel distributors, besides an increased number of exhibits of small maintenance graders built around the Fordson and McCormick-Deering tractors.

More accurate pavement subgrades are being made possible by finish graders, heavier sub-graders, and test templates all running on the road forms. In the use of gasoline-operated equipment, such as power shovels and hoists, definite development is toward operating ease and flexibility, this to be obtained by the use of air and hydraulic controlled clutches and frictions.

Some increase in the use of Diesel power was evidenced, and for the first time, Diesel engines were shown for industrial locomotives. An increase during the past year in central concreting plants resulted in the exhibit of a 56-S mixer, in the showing of closed bucket elevator systems for batcher bin charging to replace the usual clam shell bucket and in the exhibit of several especially designed truck bodies for wet concrete haulage. The development of heavier finishing machinery has occasioned more sturdy road form construction.

Usual tendencies were noted in the growth of refinements, such as electric starters, pressure lubricators, cut gears running in oil, ball and roller bearings, and steel castings. Specially evident was the increase of activity on the part of fabricating material manufacturers, who furnish to construction equipment manufacturers such products as engines, carburetors, axles, castings, radiators, magnetos, dippers, wheels, wire rope, clutches and transmissions.

The foregoing gives only the more evident trends. Others will be seen in the detailed account of the exhibits that follow, although because of space limitations, this account must be more of a recording than of an analytical nature. The outline used has been based on a functional arrangement under such major heads as grade preparation, paving and surfacing, and transportation in order that it may be the more easily read and as logical as possible.

Grade Preparation

Power Shovels and Cranes—Developments in this class of equipment centered on means to provide the gasoline powered equipment with the ease and flexibility of operation long common only to steam. That these developments are approaching success was indicated by the fact that only one steam shovel was shown at the show. Mostly these developments are evidenced in an attempt to make clutch operations easier. The Austin Machinery Corporation exhibited for the first time a gasoline shovel with hydraulic control for all the main functions supplemented by an independent gear mechanism on the crowding motion. A triplex plunger pump supplies a non-freezing liquid to an accumulator which maintains a constant working pressure of 150 lb. per sq.in. McMyler-Interstate Company showed a new air-controlled gas shovel. Three companies representing the recent consolidations of six power shovel companies exhibited their new lines. Bucyrus-Erie Company exhibited a 1-yd. Diesel shovel, introduced during the past year, a 1-yd. steam shovel, the gas + air shovel of the old Erie company, and a straight gasoline crane. The outstanding feature of these machines was the use of a new single shaft drive for the crawler unit. Industrial Brownhoist Corporation showed its line of convertible shovels from $\frac{5}{8}$ to $1\frac{1}{4}$ yd., featuring all steel construction. The Byers Machine Company by virtue of its consolidation with the Massillon Company exhibited in addition to its $\frac{5}{8}$-yd. Bearcat both in a revolving and half revolving type, a Massillon 1-yd. gas shovel equipped with roller bearings and using cast steel construction. American Hoist and Derrick Company exhibited its new $\frac{3}{4}$- and 1-yd. gas and Diesel shovels, upon which all bushings, sheaves, and bearings have been made interchangeable.

The gas-electric shovel using separate motors for all motions and a splash lubricated engine for its prime mover was exhibited by the Marion Steam Shovel Company. The Link Belt Company in addition to its crawler crane and shovel, showed a lower frame and operating gear stripped for examination of the unit cast steel construction. Besides its $\frac{3}{4}$-yd. convertible excavator, the Bay City Dredge Works exhibited its tractor-shovel built around a McCormick-Deering tractor with improvements in heavier parts, a heavy plate box-type boom with roller chain crowd in place of the old channel boom and worm crowd and a machine table with rollers in place of a chain swing. Harnischfeger Sales Corporation showed its chain driven machines in a new heavy duty 1-yd. Diesel model, and a $\frac{1}{2}$-yd.

trench hole; both a Buda and an Atlas-Imperial Diesel engine were exhibited. The pull-shovel of the Thew Shovel Company represented an important improvement, in that the dipper can be controlled at any angle by the operator. This new shovel was shown in connection with the company's 75-A Lorain center-drive machine. The Moore Speedcrane Company, with its gear shift shovel doing away with all jaw clutches and band frictions and the Star Drilling Machine Company with its telescoping boom shovel improved by the use of an electric starter, were other important exhibits. Orton Crane and Shovel Company exhibited two new gasoline models ½ yd. and 1 yd. capacity respectively. Northwest Engineering Company exhibited a 1-yd. crane, a ¾-yd. skimmer scoop, a ½-yd. pull shovel, and a 1¼-yd. shovel.

Among the other companies exhibiting shovels, and cranes, were the Browning Crane Company, General Excavator Company, Insley Manufacturing Company, Osgood Company, Speeder Machinery Corporation, Universal Power Shovel Company, Hanson Clutch and Machinery Company, and the W. M. Blair Manufacturing Company, the last three companies showing machines built around McCormick-Deering and Fordson tractors.

In the field of buckets the G. H. Williams Company exhibited a new dragline with the scoop formed from a one piece steel plate forming both the bottom and sides and a clam shell with a plate head which because it is lighter than a cast head is claimed to give the bucket better balance for fast operation. The Owen Bucket Company exhibited two new buckets for excavating and for general re-handling purposes, both featuring a one piece steel cross head. The Hayward Company exhibited its orange peel buckets, its dragline and its new K-type buckets, permitting 3-, 5- and 7-part line reeving, according to whatever class of service is required.

Grading Machinery—The most important development in this type of equipment was not in graders *per se* but in the use of crawler traction on dump wagons used in connection with grading operations. This tendency, referred to later under transportation, was seen in the exhibits of the Austin-Western Road Machinery Company, the Western Wheeled Scraper Company, the Athey Truss Wheel Company, and the Electric Wheel Company. The Western Wheeled Scraper Company exhibited a 7-yd. bottom dump wagon, mounted on Athey truss wheel crawlers as its new piece of equipment. The Athey Truss Wheel Company, exhibited a steel 10-ton rear dump trailer mounted on its crawler unit and hydraulically operated by the tractor driver. The Electric Wheel Company exhibited a small crawler unit for trailer use, featuring internal expanding-type brakes. The Gustav Schaefer Wagon Company exhibited an automatic one-man tractor scraper featuring an auxiliary back-up control, planned to increase the maneuvering ability of such equipment. Other companies exhibiting tractor scrapers and revolving fresnos included the Baker Manufacturing Company, Euclid Crane and Hoist Company, Roderick Lean Co., and the Perry Company.

ROAD SHOW EQUIPMENT

Requirements for construction and maintenance of second class roads resulted in such exhibits as that of the Wehr Company, showing a Fordson grader mounted with rear crawlers and front rubber tired wheels or cast steel wheels, that of the Stockland Road Machinery Company showing its Whippet grader, that of the Shaw-Enochs Tractor Company, showing a power grader for operation by McCormick-Deering and by Cletrac tractors, that of the W. A. Riddell Company exhibiting one-man graders built around McCormick-Deering and Fordson tractors on both crawlers and rubber tires, that of the Lincoln Steel and Forge Co. exhibiting a small road maintainer scraper, that of the Good Roads Machinery Co., Inc., showing literature on a one-man power grader and a sand spreader, that of Edward J. Jacobboice, featuring an underbody truck maintainer blade that is reversible, and that of the Root Spring Scraper Company exhibiting a truck scraper hydraulically operated by the same system that operates the truck's dump body.

Part II, Road Show Report Will Appear Jan. 26.

BECAUSE of the large number of important exhibits of highway equipment at the 1928 Road Show it is necessary to break the report into two parts. In this issue is Part I and in the issue of Jan. 26, next week, will appear the concluding part of the report. Part II will cover transportation equipment as affecting construction in addition to operation and maintenance equipment and materials. There are yet to be described:

Trucks	*Traffic Control Equipment*
Bodies and Hoists	*Engines*
Trailers	*Small Tools*
Tractors	*Fabricating Parts*
Industrial Locomotives	*Miscellaneous*
Snow Equipment	

Heavier grading equipment was exhibited by the Russell Grader Manufacturing Company, by the Banting Manufacturing Company, by the Ryan Manufacturing Corporation, which showed a motor control heavy-duty grader, by the Stockland Road Machinery Company, by the Rome Manufacturing Company exhibiting a grader with an especially high lift for ditching and similar work, by the Galion Iron Works and Manufacturing Company showing a heavy duty crawler-mounted motor grader with a new type front yoke, by the C. D. Edwards Mfg. Company with a dual blade grader built around a 15-30 McCormick-Deering tractor, and with a heavy duty grader with a 12 ft. blade, by J. D. Adams & Company showing a motor grader with a new type of blade control utilizing short lifting arms connected by means of ball and socket joints to gears located directly above the blade and by the Acme Road Machinery Company. Plows were shown by the Wiard Plow Company and wooden bottom-dump wagons by A. Streich and Bros. Company. Other dump wagons were exhibited by the Rex-Watson Corporation and the Little Red Wagon Company, the latter company also showing a heavy duty elevating grader.

Road Rollers—The outstanding trend in road rollers is toward heavier machines necessary for modern asphalt paving. In line with this requirement and the change from steam to gasoline power has come the introduction of cut worm gears and of special reversing transmissions. The Austin-Western Road Machinery Company exhibited its new three wheel Autocrat roller with worm drive and complete electrical equipment, including self starter. The Buffalo-Springfield Roller Company exhibited a 10 ton three-wheel motor roller with scarifier in addition to its large steam tandem and motor tandem rollers. Huber Mfg. Company exhibited both a five and ten ton motor roller, while Galion Iron Works and Manufacturing Company showed for the first time its new 10-ton tandem motor roller, making its line of rollers complete in 6, 7, 8, 9 and 10 ton sizes. These machines reverse without gear shift.

Fordson rollers in smaller sizes were exhibited by the Wehr Company, while the Pierce Roller Company showed a small gasoline operated roller for asphalt repair work and golf course service.

Hoists and Cableways—Hoists are undergoing the same development in the matter of motive power as are power shovels and cranes. All hoists exhibited were either operated by gasoline engines or electric motors. The most important improvement was shown by the Clyde Iron Works with a double drum 45 hp. gasoline hoist, utilizing a hydraulic mechanism to operate the asbestos lined frictions. Ease of operation, safety, and flexibility are claimed advantages. A new 80 hp. two-drum hoist was exhibited by the Lidgerwood Manufacturing Company. Although of all steel construction it is claimed to be 40 per cent lighter than other hoists of similar capacity. It is equipped throughout with roller and ball bearings, and all gears are totally inclosed, running in oil. The drive shaft is adjustable, so that any type electric motor can be used up to the 80 hp. size. A slackline excavator hoist electrically operated through flexible couplings, and providing two speeds by means of clutches to a 2 yd. bucket was shown by the S. Flory Manufacturing Company, as was a chain driven 1,500 lb. hoist and a gear driven 5,000 lb. general utility hoist. Working models of cableways together with slackline and power scraper buckets with a new wire rope block for

slackline operation were shown by Sauerman Bros. The C. H. & E. Mfg. Company exhibited a heavy duty hoist, while the O.K. Clutch and Machinery Company and R. H. Beaumont Company exhibited a two-speed slackline hoist and working models of a cable drag scraper and slackline system respectively.

Subgraders—A number of manufacturers exhibited machines for operation on the road forms cutting the final grade to a finished surface. A. W. French Company exhibited a new finish grader of a self propelling type which in addition to cutting the rough spots from the subgrade carries the dirt on a belt conveyor to the outside of the forms. The Koehring Company exhibited a subgrade planer for attachment to its heavy-duty paver. In addition to its subgrader, the Lakewood Engineering Company exhibited a subgrade tester as an aid to proper finishing and a grade rooter, a scarifier-type machine for heavy subgrade work. The Hug Company also exhibited a subgrading machine and a subgrade tester.

Air Equipment — Compressors and air operated tools, although in many instances improved in mechanical detail, exhibited no outstanding development. Among the most important was a new 240 cu.ft. portable machine shown by the National Brake and Electric Company. This unit consisted of a gasoline engine direct connected to a compressor both mounted on a unit steel-casting frame with semi-elliptic springs. The compressor of 6 cylinders has 4 low pressure cylinders arranged in V-type and two high pressure cylinders set vertically, this arrangement claiming to assure perfect balance and eliminate all vibration. This machine was equipped with electric starter, as was also the new 330 cu.ft. model exhibited by Metalweld, Inc. These electric starters have made possible the elimination of clutches between engine and compressor which is claimed to produce a more sturdy machine. Sullivan Machinery Company exhibited its new 120 cu.ft. semi-portable electrical compressor, in addition to its air hoist and numerous air-operated tools. These tools comprised paving breakers, backfill tampers, calking hammers, spades, hammer drills, riveting hammers, and similar equipment. The Independent Pneumatic Tool Company exhibited its Thor Six portable compressor using a super charger. In addition, this company showed a pneumatic wrench for tightening large nuts on water mains. Other companies exhibiting portable compressors and air tools included the Curtis Pneumatic Machinery Company, the Gardner-Denver Company, the Buhl Co., the O.K. Clutch and Machinery Company, Schramm, Inc., Pontiac Tractor Company, Chicago Pneumatic Tool Company, and Ingersoll-Rand.

Culverts—Armco Culvert Manufacturers' Association exhibited its corrugated pure iron culverts and in addition showed several new developments. A culvert was exhibited using a paved bituminous invert for use in acid and highly erosive conditions. A complete set of fittings was shown for culvert and drainage pipes, so that special fixtures are not any more required. The company's perforated culvert pipes for road and railroad grade drainage purposes were also exhibited. Central Alloy Steel Corporation showed its molybdenum corrugated iron culverts, while the American Castings Company exhibited spiral corrugated cast iron pipe together with cast iron head walls making a complete culvert installation. In addition a new cast iron extension for box culverts and several sections of the company's lock-joint cast iron culvert pipe was shown. A corrugated culvert was also exhibited by the Northfield Iron Company, and the Burch Corporation showed a cast iron culvert separated into semicircular sections.

ROAD SHOW EQUIPMENT

Trenchers — New developments in trenching machines exhibited themselves in small models. The Cleveland Trencher Company, in addition to exhibiting its wheel type Baby digger improved with wider crawlers and greater speed and capacity on the digging wheel, showed a new ladder-type machine with a capacity for digging 10 ft. in a 30-inch trench. The machine is compact, weighing 6½ tons and is 4 ft. 10 in. overall width. One of the most important features is a pivot conveyor which can be rotated 180 deg., thus providing an adjustable discharge as needed. New small ladder-type trenchers were also shown by the Austin Machinery Corporation featuring two speeds on both its excavator chain and its conveyor belt and by the Buckeye Traction Ditcher Company. The larger trenching machines digging down to 15 ft. were exhibited by the Harnischfeger Sales Corporation and the Buckeye Traction Ditcher Company, the latter company also showing a small back filler crane. Barber-Greene exhibited its vertical boom ditcher also featuring a trailer for transporting the trencher from job to job. The Parsons Company was represented with an exhibit of its back fillers and trenching machines by means of miniature models.

Paving and Surfacing

Concrete Mixers—Improvements continue on the pavers and small mixers used in the highway industry. With regard to the paver, the improvements are in line with faster operation and longer life, while for the smaller mixers portability and better and smoother operating machine parts are the principal objects in view. Too, water control receives additional attention year by year. The Chain Belt Company contributed the most outstanding development by providing on its 27-E paver a so-called "mechanical man." This is a mechanism which the operator sets in motion by pulling one lever which starts the skip, closes the discharge, opens the water valve and closes the water valve, all operations being so timed that they overlap to the greatest extent possible. The special siphonic water system introduced last year is claimed to place 25 gal. of water in the drum in 7 seconds. The company also exhibited a 28-S central mixing plant with an inclosed bucket elevator charger. Smaller plaster and building mixers were also shown. The 27-E paver of the Foote Company completely Timken roller bearing equipped was shown with a new power-operated top frame, giving a clearance of only 12 ft.

The largest mixer shown was a 56-S central plant exhibited by the Ransome Concrete Machinery Company in addition to its 27-E paver and its new model 5-S building mixer. T. L. Smith Company's 27-E paver featured a new water tank of an entirely new design operated similarly to the measuring pump used at gasoline filling stations. The new paver uses the single unit frame, and is 600 lb. heavier than last year's model. Another feature is the use of a bevel gear reverse inclosed in an oil tight case. The Koehring Company contributed a new development in a built-in calcium chloride attachment on its 27-E paver. The indicator on the water control has also been placed near the tank to insure more accuracy. Replaceable wearing plates have been added to the skip and boom buckets. The company also exhibited its 10-S building mixer with worm-drive direct power transmission. Lakewood Engineering Company exhibited its 10-S mixer with automobile type transmission, the Jaeger Machine Company its portable power loading mixers, including a paving mixer and building mixer mounted on special wheels adaptable both to city streets and to places where traction is necessary, the Marsh-Capron Co. a new 10-S mixer with large charging and discharge openings, and the Knickerbocker Company its 21-S and 10-S mixers with cast steel drums and centralized control on the drum end together with a new water measuring device operating by a siphonic action. Other exhibitors were the American Cement Machine Company with a 10-S mixer using a power loading device, the Standard Scale and Supply Corporation exhibiting a 7-S power loader mixer and a 3½-S trailer tilting mixer, John Lauson Mfg. Company showing a 3½ cu.ft. trailer mixer and a 5 cu.ft. plaster mixer, and the Leach Company showing a 21-S, a 14-S mixer and a 4 cu.ft. mixer trailer. The Republic Iron Works and the Orr & Sembower Inc., exhibiting its gear-drive mixers on steel-wheel trucks.

Finishing Machines and Road Forms—Finishing machines are growing in weight and as a result heavier road forms have been developed. Heltzel Steel Form and Iron Company exhibited a very heavy type of road form, using a steel lock wedge between the side and the face of the rail. The form is simplified so that one blow of a hammer

locks it and aligns the rail. This company also exhibited one of its flexible road plane machines for placing both transverse and longitudinal joints in pavements without the use of expansion plates. A new screed developed for half width highway construction was shown by the Lakewood Engineering Company, adjustable for widths of 9 and 10 feet. This machine is also adaptable for finishing widened curves by means of its sliding wheels thus eliminating the necessity for special forms. A. W. French & Company exhibited its Ord road finisher in addition to a power belting machine. The Blaw-Knox Company exhibited a complete line of road forms and in addition its steel forms for street, curb and sidewalk construction. Hotchkiss Steel Products Company showed its improved forms with five rail supports on every 10-ft. section. Other exhibitors were the Metal Forms Corporation and the Concrete Surfacing Machinery Company, the latter with a new machine known as the highway surfacer. The machine is one-man operated, consisting of a rotating cutting tool connected through gears to a gasoline engine. It is adaptable for cutting down high spots, uneven expansion joints and repair patches on both new and old pavements.

Aggregate Handling Equipment—For handling concreting materials such as sand, stone and cement, there were exhibited belt and bucket conveyors, crushing and screening plants, bins and batching plants. The bucket loader, Model 27, of the George Haiss Mfg. Company, Inc., was shown with improvements in its crowding worm drive. The Model 16 creeper loader using only two clutches, one for elevating and one for traction, was also exhibited. Perhaps the most outstanding feature was the use of a weighing hopper attached to the end of the bucket loader for use in weight batching of aggregate. The Chicago Automatic Conveyor Company exhibited a portable belt conveyor with a non-clogging receiving end and a two-high shaker screen attached to its discharge end. Barber-Greene Company exhibited its bucket loaders with self feeding disks and portable belt conveyor installations with shuttle belt for changing the direction of material discharging from a main belt conveyor line. Bucket loaders were also exhibited by the N. C. Nelson Iron Works, Inc., and the Link Belt Company. The Blaw Knox Company exhibited a 51-ton hinged leg portable bin equipped with double weighing batchers and a 100-ton portable pedestal type bin equipped with the inundation system for road construction. This company also showed an all steel batch box and its calcium chloride machine. The Heltzel Steel Form and Iron Company exhibited a portable bin with adjustable volume hopper and an enclosed bucket elevator system. Other bins and volumetric and weighing batchers were exhibited by the Butler Bin Company, C. F. Johnson Company and the Erie Steel Construction Company. Model crushing and screening plants were exhibited by the Russell Grader Manufacturing Company, and the Smith Engineering Works. The Deister Concentrator Company exhibited a double surface motor driven screen and a model of its patented Leahy screen with a special motion for which unusual efficiency is claimed. Crushers were exhibited by the Universal Crusher Company and the Williams Patent Crusher and Pulverizer Company.

ROAD SHOW EQUIPMENT

Pumps—For pumping service in connection with 27-E paving mixer operation, development over the past few years has been toward the triplex pump with all gears operating in an oil bath. This tendency is still in force and improvement changes were evident only in improved mechanical details. Humphryes Manufacturing Company exhibited again its double 4 in. horizontal outside packed plunger trench pump. Triplex pumps were exhibited by the Domestic Engine and Pump Company, Barnes Mfg. Company, Novo Engine Company, and the C. H. & E. Manufacturing Company. All of these companies also exhibited diaphragm and centrifugal pumping outfits. An entirely new idea in pumping was shown by the Homelite Corporation in the form of a small portable centrifugal pump which is operated by a 1½-hp. single cylinder air-cooled engine. A. S. Marlow exhibited a new open diaphragm pump for which is claimed unusual capacity because of its especially designed pump body. He also exhibited a single and double convertible plunger diaphragm-force pump operated through gears by a 4- or 8-hp. gasoline engine. American Steam Pump Company exhibited a Barton centrifugal pump for attachment to Ford engine crankshafts, the Morris Machine Works showed a 4-in. dredge pump connected to a Ford engine, Fairbanks Morse & Company exhibited centrifugal pumps, and the Ralph C. Carter Company showed diaphragm-force pumps and a portable diaphragm model completely inclosed and mounted on steel tires.

Pavements and Surfaces—Under this head has been segregated the asphaltic materials, the admixtures and curing chemicals for concrete roads, reinforcing steel, special types of pavement, and the equipment for surfacing second-class roads. Companies featuring asphalt products included the Texas Company, Ohio Valley Rock Asphalt Company, Marble Cliff Quarries Company, Kentucky Rock Asphalt Company, Hastings Pavement Company, Barber Asphalt Company, Asphalt Brick Company, Asphalt Association, Amiesite Asphalt Company of America, and the American Tar Products Company.

The Portland Cement Association maintained a general exhibit. Bituminous expansion joints and rail fillers were exhibited by the Philip Carey Company, W. R. Meadows, Inc., and the Servicised Products Company. The Carey company also exhibited a new bridge flooring, being an asphalt preparation using rag fibre and mineral matter. The Grasselli Chemical Company demonstrated its method of applying silicate of soda for concrete road work. Celite Products Company showed its diatomaceous silica, while the Solvay Sales Corporation showed its calcium chloride and the Dow Chemical Company exhibited its Dowflake, also a calcium chloride for concrete curing. Other companies exhibiting were the Atlas Lumnite Cement Company, and the Perforated Concrete Roller Works, the latter showing a small roller designed to bring the water to the top of a freshly-poured concrete slab.

Reinforcing steel was shown by the Truscon Steel Company, Joseph T. Ryerson, Rail Steel Bar Association, National Steel Fabric Company, American Steel & Wire Company, Wickwire Spencer Steel Company, W. G. Godwin Company, Inc., Concrete Steel Company, and the Duplex Steel Reinforcement Company. For second class road construction, the Burch Corporation exhibited a stone spreader, Chas. Hvass & Company a chip spreader for rear end truck application, the Highway Products Company a large sand, cinder and gravel spreader pushed by a Fordson tractor and covering a half width of pavement, and the Goroco Mechanical Spreader Company showed a chip spreader for attachment to the rear end of motor truck dump bodies.

Special type pavements were shown by American Vibrolithic Corporation, with samples and movies of its vibrolithic concrete and interlocking bituminous pavement, and by the Sheet Concrete Pavement Corporation, showing a patented two-course pavement a feature of which is a removable top course for replacement and repairs.

Other exhibitors were the National Paving Brick Manufacturers Association and the Alan Wood Iron and Steel Company, the latter showing a bridge floor equipped with its steel traffic treads.

Bituminous Equipment—Development in this class of equipment has centered on mechanical details, no radical outstanding changes having been made. Special distributors mounted on motor trucks were exhibited by Chas. Hvass & Co., the Kinney Manufacturing Company, the Barrett Company and E. D. Etnyre & Company. Portable asphalt plants were featured in literature by F. D. Cummer & Son Company, by the J. D. Farasey Mfg. Company, and by the Doorley Asphalt Plant Company. Asphalt heaters, small portable plants and repair outfits were shown by Chausse Oil Burner Company, Littleford Bros. Company, and the Mohawk Asphalt Heater Company. The Good Roads Equipment Company exhibited one of its pavement heaters for repairing asphalt streets.

Part II—Next Week

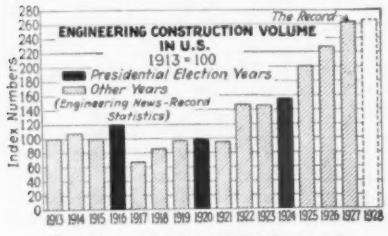
In these pages, Jan. 26, will appear the concluding part of the Road Show Report.

Business Side of Construction

Facts and Events That Affect Cost and Volume

Construction in Presidential Years 1916—1920—1924

THIS is a presidential year. Will the fact have an unfavorable effect on contract letting? Not according to the volumes of the last three presidential years, when more money was spent for both total construction and heavy engineering construction than in any of the three preceding years. Not only this, except in the case of total construction in 1920, more actual construction was placed, as shown by the chart of heavy engineering construction and the table which gives the figures for both engineering and total construction.



(In millions of dollars—000,000 omitted)

	Total Construction Value	Physical Volume (1913=100)	Engineering Construction	Physical Volume (1913=100)
1913	$1,600	100	$601	100
1914	1,500	106	583	107
1915	1,600	106	585	100
1916	**2,400**	**113**	**933**	**119**
1917	2,600	88	739	67
1918	3,200	106	993	86
1919	3,400	106	1,176	98
1920	**3,600**	**88**	**1,523**	**99**
1921	3,500	125	1,194	96
1922	4,900	150	1,557	147
1923	5,400	151	1,904	146
1924	**6,000**	**175**	**1,999**	**154**
1925	7,500	225	2,559	201
1926	7,800	234	2,853	228
1927	7,800	236	3,253	263

The table shows that there was no falling off in construction programs in presidential years but actually that distinct gains were made in the amount of money expended. In fact, each year seems to follow the one before with economic regularity. Certainly the years 1916, 1920, and 1924, reveal no distinctive characteristics. Quite probably 1928 will slip by as naturally as any one of the years that preceded it, and yield its necessary harvest of projects.

This Week's Contracts

Heavy construction contracts reported by *Engineering News-Record* in the week ended Jan., 19, with some comparisons, total as follows:

(In Thousands of Dollars, 000 Omitted)

Week Ended	Public	Private	Total
Jan. 19, 1928	$14,132	$31,879	$46,011
Jan. 12, 1928	30,791	30,342	61,133
Jan. 20, 1927	8,672	30,042	38,714
Jan. 1 to date:			
1928	64,341	106,292	170,633
1927	47,399	80,126	127,525

E. N.-R. Index Numbers

Cost		Volume	
Jan. 1, 1928	203.90	December, 1927	319
Dec. 1, 1927	203.90	November, 1927	272
Jan. 1, 1927	211.50	December, 1926	188
Average, 1927	206.24	Average, 1927	263
Average, 1926	208.03	Average, 1926	228
1913	100.00	1913	100

Public Improvement Bond Sales Reach New High Record in 1927

With the last few days of December estimated, the 1927 state and municipal borrowing total (short term financing not included) will fall short of $1,500,000,000 (estimated Dec. 2) by a slight margin, but will, nevertheless, establish a new record for all time at approximately $1,470,000,000, according to *The Daily Bond Buyer* of New York. The largest previous yearly total was recorded in 1924 when bond emissions aggregated $1,446,688,993.

December, 1927, sales of about $105,000,000 are below those of the corresponding month in the two preceding years, as will be noted in the accompanying table.

In recent years it has been predicted, over and over again, that municipal borrowing would not continue in the volume to which this class of financing has expanded since 1920. Such predictions have each time proved unsound and it is gradually becoming a recognized fact that the normal requirements of the states, counties, cities and smaller municipalities for capital funds are several times greater than in the pre-war years.

The following table, compiled by *The Daily Bond Buyer* of New York, offers a ten-year comparison of state and municipal long-term borrowing in the month of December and totals for the full calendar years, 1918 to 1927:

	December	12 Months Ended Dec. 31, 1927
1927	$105,000,000*	$1,470,000,000
1926	147,246,926	1,362,037,801
1925	166,272,700	1,404,702,240
1924	73,600,315	1,446,688,993
1923	97,346,640	1,155,167,134
1922	53,497,002	1,279,553,134
1921	313,745,876	1,383,368,900
1920	81,556,865	773,663,986
1919	89,586,091	770,195,248
1918	25,884,277	262,818,844

* Partially estimated.

Price Changes of Principal Materials

Important price changes occurred recently in cast-iron pipe, Douglas fir timbers and linseed oil.

Cast Iron Pipe—San Francisco price on Class B and heavier, 6-in. and larger, is $39 per net ton, a rise of $1 since Jan. 9. Milwaukee quotations are as low as $34.35 per ton delivered ($25.85 in Birmingham). In Atlanta 6-in. pipe is $31, down $5.50 since Jan. 7.

Douglas Fir Timbers—Price at Seattle has moved from $24 per M. ft., on Jan. 1 to $20, for 3x12 to 12x12-in., 20-ft. and under. Decline in production noted until a week ago in Northwest fir district may prevent further price recession.

Linseed Oil—Raw, in 5 bbl. lots, per 7½ lb. gal., is 76½c. at Chicago and New York. On Jan. 5 the Chicago price was 83c. and New York, 79½c. These lower prices may only be temporary, as there has been a sharp advance in flaxseed generally. According to Archer-Daniels-Midland Co., crushers, Minneapolis, a recent advance in the price of Argentine seed was due to heavy demand from Europe. Argentine prices, by the way, now determine the flaxseed market, displacing Duluth.

In the iron and steel market a revival of demand is noted in pig iron at Birmingham; orders are for first-quarter delivery. Steel plates, shapes, sheets, and railway car materials lead in current buying at principal distributing centers throughout the country. Dull market conditions prevail in tie plates, spikes and light rails, owing largely to the depression in the coal industry. Steel bars, plates and shapes since October, 1927, have held firmly to $1.80 per 100 lb., Pittsburgh.

VALUE OF 1927 HEAVY CONSTRUCTION CONTRACTS REPORTED BY ENGINEERING NEWS-RECORD

Thousands of dollars (-000 omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	U. S. 1927 Totals	U. S. 1926 Totals	Canada
Waterworks	$3,650	$8,283	$5,201	$14,336	$12,818	$8,901	$53,189	$61,647	$3,988
Sewers	2,837	25,995	4,560	55,112	14,541	14,987	118,032	103,741	4,641
Bridges	8,668	38,821	25,578	46,028	16,958	7,592	143,645	83,383	9,590
Excavations, drainage, etc.	3,757	4,709	9,416	6,319	13,237	4,567	42,005	27,810	4,783
Streets and roads	18,226	118,015	79,069	111,928	128,160	69,671	525,096	484,898	11,437
Industrial buildings	32,329	69,262	72,021	63,229	41,407	43,067	321,315	311,665	26,463
Commercial buildings	154,516	619,285	57,087	454,061	156,827	190,562	1,632,338	1,485,946	81,365
Federal government	3,135	15,737	8,341	4,924	6,347	12,279	50,763	50,262	.....
Unclassified	7,156	88,887	29,192	20,018	203,122	19,035	367,410	244,495	38,496
Total, 1927	$234,274	$988,994	$290,465	$775,955	$593,417	$370,661	$3,253,766	.....	$180,763
Total, 1926	246,595	856,327	288,891	724,428	414,962	322,644	.....	$2,853,847	143,686